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Long March 2E Payload Fairing Separation System

93FE0093A Beijing ZHONGGUO HANGTIAN [AEROSPACE CHINA] in Chinese No 9, Sep 92 pp 11-15

[Article by Li Changchun [2621 7022 4783] of the Beijing Institute of Space Systems Engineering: "Long March 2E Launch Vehicle Payload Fairing Separation Technique"]

[Text] **Abstract**

Because of the poor stiffness and large elastic deformation of a large payload fairing, the design of its connecting, unlocking and separation system is very difficult. The large fairing of the Long March 2E (LM-2E) launch vehicle uses the "translation and turn-over" separation technique. Unlike the conventional clamshell separation scheme, this technique uses frangible bolts and detonating cords to unlock the fairing; during separation, the half-fairing is first translated over a distance of 15 mm, then rotated about the hinge axle under the action of a spring torque. Such a scheme avoids the problem of collision and elastic deformation during translation. This separation technique has been successfully tested during flight.

[Introduction]

On the LM-2E launch vehicle, a large fairing is used to accommodate a 9,200-kg payload; one of the problems with a large fairing is the difficulty in designing the connecting, unlocking and separation system because of its poor stiffness and large elastic deformation. The LM-2E fairing is split into two symmetric half-fairings which are separated using the "translation and turn-over" technique. A detailed description of this technique is given in this paper.

I. Connecting and Unlocking Procedure of the Fairing

Figure 1 shows the overall dimensions of the payload fairing, whose usable space is indicated by the shaded area. Figure 2 shows the configuration of the separation system.

Due to constraints imposed by railroad shipping considerations, the fairing is divided into four pieces; after arriving at the technical center of the satellite launch site, the four pieces are assembled into two half-fairings. The boundaries of the first and third quadrants are the connecting surfaces or the axial separation surfaces of the two half-fairings.

The separation surface of the half-fairing has a long circumference. In an effort to reduce the number of explosive devices and to improve the reliability and integrity of connecting the two half-fairings, they are connected by detonating cords. The detonating cord has a flexible sealed structure which is unaffected by the gas pollution generated by the explosion.

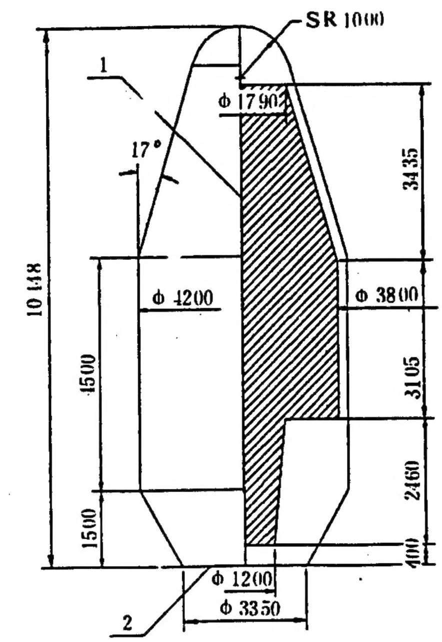

Figure 1. Overall Dimensions of the Payload Fairing

1. Axial separation surface; 2. Radial separation surface

The fairing and the rocket body are connected by 12 non-polluting frangible bolts (with position restraining pins).

When the rocket reaches a designated altitude, commands of fairing separation are issued by the onboard control system. The first command detonates the 12 frangible bolts which unlock the fairing along the lateral cross section of the rocket; the second command causes the detonating cords to explode, and completes the unlocking of the fairing along its axial cross section. The time difference between the two commands is 0.1 sec.

II. Fairing Separation Scheme

In designing the fairing separation scheme, a key requirement is that a safe distance between the separated object and the rocket body must be maintained in order to avoid collision. The dangerous spot for collision to occur is between the lower edge of the inverted-cone section of the half-fairing and the protruding part of the rocket; the time of collision danger is the extremely short interval immediately following fairing separation. To avoid collision, it is essential that the half-fairing have sufficient lateral velocity after separation.

In the separation scheme of the LM-2E fairing, the detonating cord is used only for unlocking the fairing in the axial direction. After the connecting rivet is broken by the detonating cord, each half-fairing will be in translational motion for 15 mm until it is stopped by collision with the hinge axle. This collision will excite the natural low-frequency vibration of the half-fairing, and cause large deformation in the fairing axis and curvature.

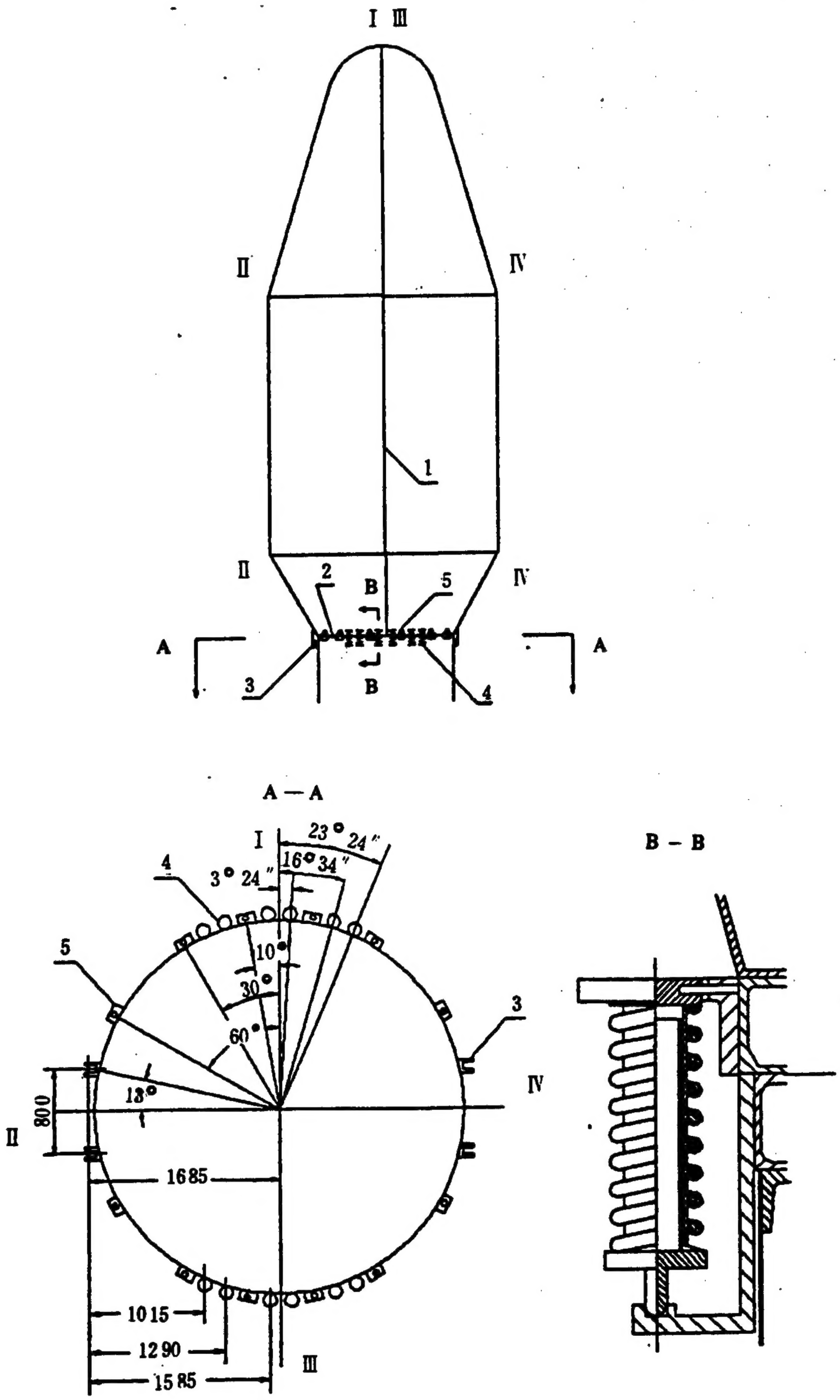

Figure 2. Configuration of the Fairing Separation System

1. Surface on which the detonating cord is located; 2. Surface on which the frangible bolt is located; 3. Separation hinge; 4. Separation springs; 5. Frangible bolt

This technique is given the name "translation and turn-over separation" because it differs considerably from the conventional clamshell separation scheme.

In designing the turn-over separation system, two technical terms must be clearly defined. First, the attitude of the fairing is called "center-of-mass top-over" when the line connecting the center-of-mass of the fairing and the turn axle is parallel to the direction of flight overload; and the corresponding angular velocity of the half-fairing is called the "top-over angular velocity." The latter is a critical parameter which reflects how reliably the turn-over motion will be completed; its value must be greater than zero in the design of the separation system.

After being unlocked by the detonating cords, the half-fairing is turned over by a spring torque, and is constrained by the hinge to rotate about the turn axle; finally, it is separated from the rocket body by centrifugal force. Each spring is hinged at both ends, and is equipped with guide tubes which operate like two levers; the spring is also separated from the rocket along with the half-fairing. The operating load of the spring is 2940N, and the total travel is 0.135 m.

The separating hinge is designed to accommodate the translational motion of the half-fairing. It is equipped with a backstop device to prevent the half-fairing from rebounding after colliding with the hinge. After collision, the half-fairing is constrained by the hinge to rotate only about the turn axle of the rocket. To provide additional safety margin, the hinge also ensures that the lateral velocity of the fairing center-of-mass reaches a maximum when it separates from the rocket. Each half-fairing has two symmetrically placed separating hinges (see Figure 2); the hinge axle is rigidly attached to the rocket body, and the open axle-sleeve is attached to the half-fairing. The structure of the separating hinge is shown in Figure 3.

It has been shown by theoretical analysis that after taking into account elastic deformation of the structure, only two springs are required for each half-fairing to execute the turn-over. This is the critical "top-over" state of the half-fairing. To improve reliability, the separation power unit has been designed using a safety factor of 3, and six symmetrically placed springs are installed outside the half-fairing. Also, since the initial spring force is approximately 1.8 times the gravitational force acting on the half-fairing during flight, one can make use of this initial force to change the boundary conditions of the hinge support, thereby reducing the amplitude of the elastic deformation.

III. Design Conditions for the Fairing Separation System

The design conditions of the fairing separation system are based on the dynamic conditions at the time of fairing separation; the flight overload coefficient in vacuum is 0.92. After a translation of 15 mm, the half-fairing collides with the hinge; the collision produces an initial velocity of 3 deg/sec in the half-fairing before it is turned over by the spring torque. When the fairing is unlocked by the 12 frangible bolts, it is pushed upward by the 12 springs. Clearly, the effectiveness of the spring torque is less than 1 because of elastic deformation; here it is assumed to be 0.7.

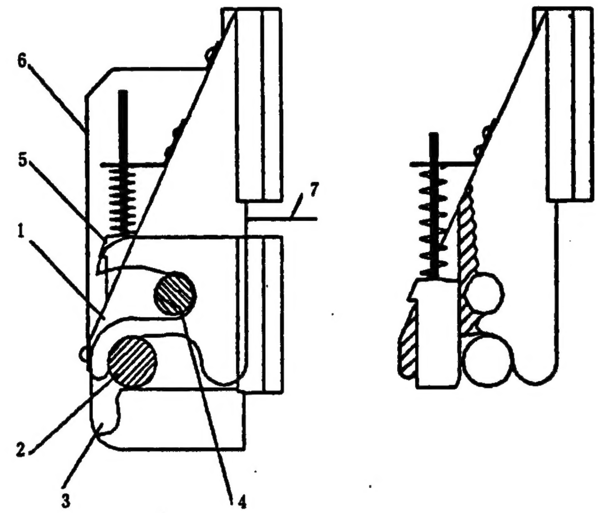

Figure 3. Structure of the Separating Hinge

1. Open axle-sleeve; 2. Hinge axle; 3. Hinge seat; 4. Position restraining pin; 5. Backstop pin; 6. Protective shield; 7. Separating surface between the fairing and the rocket

The half-fairing has a mass of 1,000 kg and a moment of inertia about its turn axis of 31,600 kg-m^2. The design assumes that the mass properties of the two half-fairings are completely symmetrical.

IV. Fairing Separation Tests

First, three developmental tests of the separation system of the LM-2E payload fairing have been conducted. After all the design parameters were finalized, two acceptance and verification tests were carried out. All five tests were successful, but only the data from one verification test are presented here.

The purpose of the verification test is to verify the angular velocity data of the half-fairing during turn-over, to validate the separation technique, to validate the operation of the separating hinges and springs, to validate the reliability of the separation components, and to verify the separation boundary data.

The contents of the verification tests include the following: simulation of the flight environment, and integrated testing and inspection of the power system and the action parts. In order to verify the reliability of the separation scheme, repeated tests must be performed and each test must be successful.

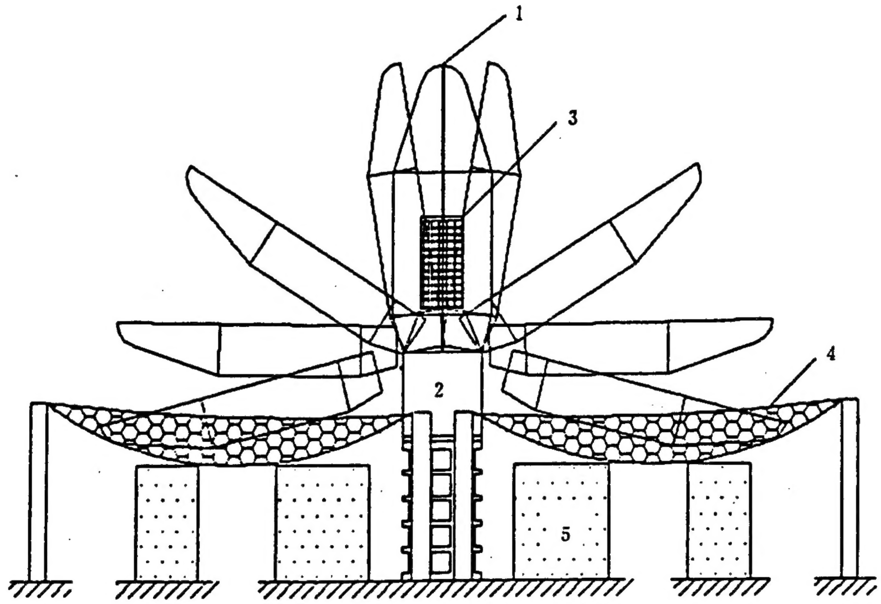

Figure 4. Schematic Diagram of the Test Configuration

1. Fairing; 2. Simulated final stage of the rocket; 3. Simulated satellite; 4. Receiving net; 5. Vibration absorbing material

The test models include the fairing, the fairing separation system (i.e., the separation hinges, springs, detonating cords and frangible bolts). The technical performance of the test models is identical with that of the flight components.

Figure 4 shows the overall configuration of the separation test. Inside the fairing, mouse-cage-type simulated components are located on a satellite support frame.

The tests are carried out under ordinary atmospheric conditions. The simulated flight overload is 1 g. Since the bottom of the inverted-cone section of the fairing is partially open, when the fairing is in motion, the effect of negative pressure inside the fairing and the effect of air resistance are partially compensated. Therefore, these effects are ignored during the test, thus introducing a slight difference between the simulated environment and the flight environment.

During the test, a control program is used to simulate the separation procedure, and the separation commands are issued by the control system.

The angular velocity data from the two acceptance and verification tests agree very closely with one another; here, only one set of data is presented for comparison with theoretical data, as shown in Figure 5 and Figure 6.

In Figure 5, the vibrations indicated by the data shortly after turn-over are caused by the collision between the half-fairing and the turn axle. At 0.97 sec after turn-over, energy release of the six springs is completed, and the center-of-mass top-over of the half-fairing is about to occur. At this point, the effects of gravitational torque and changes in the angular velocity can be ignored, hence the curve approaches horizontal.

Because of atmospheric effects, the test data of the fairing velocity tends to be quite low, and the time of separation from the rocket tends to be late. Since the velocity of the test model is also low and the effect of air resistance is small, the test data and the theoretical data are in good agreement.

Theoretical analysis shows that at the time of collision danger, the separation system can guarantee a clearance of 0.28 m between the half-fairing and the protruding part of the rocket body. This result has been verified by ground tests which show that the clearance distance is approximately 300 mm.

The verification test is a complete test not only of the separation system but also of the fairing structure. In the tradition of China's launch-vehicle development program, the fairing separation technique can be implemented for in-flight service only after a certain number of successful tests have been conducted and the reliability of the separation system is fully established.

The two acceptance and verification tests were completed successfully under simulated flight conditions. During the tests, the unlocking functions were carried out reliably by the detonating cords and the frangible bolts; the elastic deformations were within design limits;

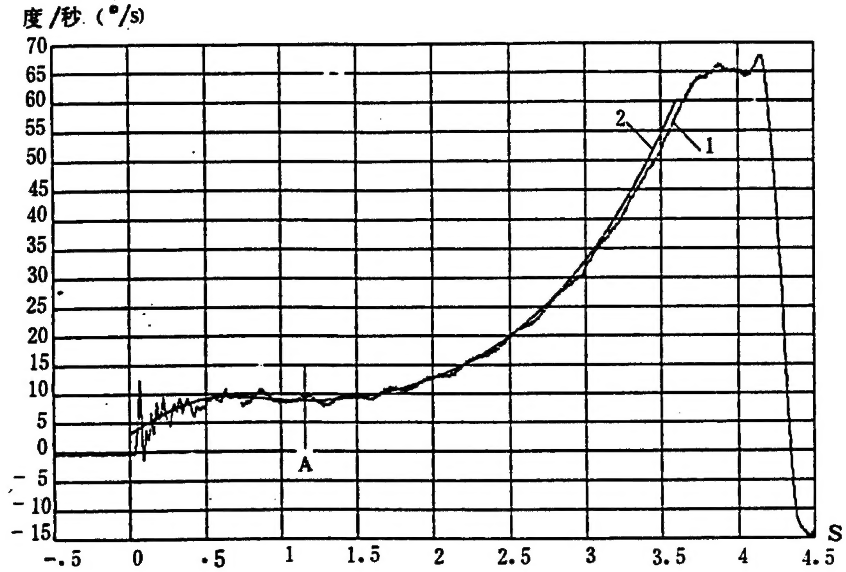

Figure 5. Comparison Between Test Data and Theoretical Data of the Angular Velocity of the Half-Fairing During Turn-Over

1. Test data; 2. Theoretical data

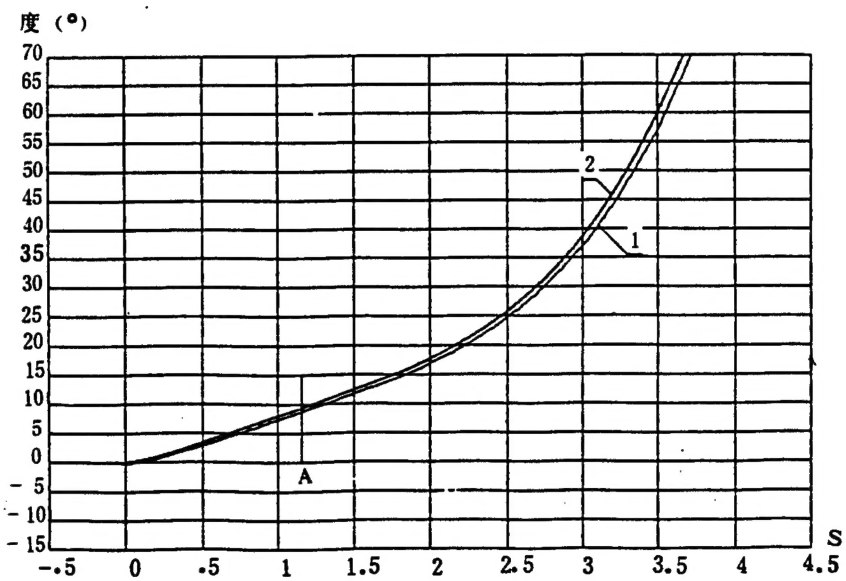

Figure 6. Comparison Between Test Data and Theoretical Data of the Angular Displacement of the Half-Fairing During Turn-Over

1. Test data; 2. Theoretical data

the top-over angular velocity reached 9°/sec, which ensures topping-over of the fairing center-of-mass; and the fairing hinges and springs all functioned according to design specifications. The data from the two tests were in close agreement, and the separation motions were repeatable. These results have fully demonstrated the reliability of the "translation and turn-over" separation technique and its readiness for in-flight service.

V. Possible Disturbances Caused by Fairing Separation

Because collisions between the two half-fairings and the hinges may not occur at the same time, and differences in the mass properties may exist, there may be slight deviations in the times of separation which can cause disturbances in the flight attitude of the rocket. However, these disturbances can be adequately corrected by the onboard control system to ensure that the preprogrammed attitude profile of the rocket will be maintained during flight.

On 16 July 1990, successful separation of the fairing of the LM-2E rocket was demonstrated by the injection of a Pakistanian satellite, the BADR-A, into orbit. On the other hand, telemetry data showed disturbances in the roll, yaw and pitch attitudes at the time of fairing separation; these disturbances were of the same order of magnitude as high-altitude shear winds. The attitude error was corrected by the second-stage engine within 1.5 sec, which proves the robustness of the LM-2E launch vehicle in overcoming disturbances.

VI. Motion of the Fairing During Separation

On the basis of theoretical data, Figure 7 shows the separation procedure of the two half-fairings and indicates the clearance between the fairing and the rocket body at the instant of collision danger. In the figure, t = 0s refers to the instant when the fairing begins to turn over; t = 1.57s is the instant when the center-of-mass tops over; t = 3.6s is the instant when the half-fairing separates from the rocket; and t = 4.155s is the instant of collision danger. The figure also shows the relative positions of the half-fairings and the rocket at t = 4.5s and t = 5s. Ground test data has proved that Figure 7 gives an accurate description of the fairing separation procedure.

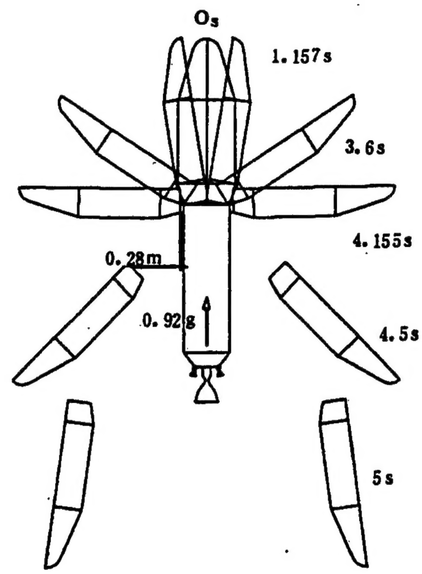

Figure 7. Schematic Diagram of Fairing Separation

Development of Nanocrystalline Silicon Thin Films

93P60087A Beijing ZHONGGUO KEXUE, Series A, in Chinese No 9, Sep 92 pp 995-1001

[Article by He Yuliang [0149 1342 0081], Liu Xiangnuo [0491 3276 1226], and Wang Zhichao [3769 1807 6389] of the Department of Physics, Nanjing University, Nanjing 210008 and Cheng Guangxu [4453 0342 3563], Wang Luchun [3769 6424 2504], and Yu Shidong [0151 2508 2639] of the Solid-State Microstructures Laboratory, Nanjing University, Nanjing 210008: "Development of Nanometer Silicon Thin Films," supported by grant from NSFC; MS received 27 May 91, revised 9 Nov 91]

[Abstract] Amorphous silicon thin films (a-Si:H), microcrystalline silicon thin films (μc-Si:H), and nanometer-sized silicon thin films (nc-Si:H) have been deposited via a heavily hydrogen diluted silane and a strictly controlled PECVD [plasma-enhanced chemical vapor deposition] process. Growth process parameters for the nc-Si:H films are as follows: prevacuum in the reaction chamber is 1.33322 Pa, vacuum at deposition time is 173.319-199.983 Pa, substrate temperature is 300°C, reaction gas ratio $SiH_4/(SiH_4 + H_2)$ is 0.6-1.0 percent, HF power supply frequency is 13.56 MHz, output power is 0.44 W/cm^2, and DC bias voltage is 0 to -400 V. HREM, Raman and X-ray spectroscopy are employed to study the structural characteristics of the nc-Si:H films. Measured results—average particle size of 3-5 nanometers, crystal-state volume percentage of 50 +/- 5 percent, inter-crystalline-particle boundary thickness of 2-4 atomic layers, room-temperature conductivity of 10^3-10^{-2}/Ω-cm, and room-temperature Hall mobility of 3-5 cm^2/V-s—demonstrate that these films match the international state-of-the-art for solid-state nanomaterials. Seven figures show various graphs of the data and a HREM photograph of a nc-Si:H sample, and one table lists various structural parameters and performance characteristics. References: 9 English, 5 Chinese.

Mechanism of Strengthening, Toughening by Zirconia in Mullite-Zirconia Composite

40100042A Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 4, Aug 92 pp 353-359

[English abstract of article by Liu Qian, Chen Yuru, et al. of the Department of Materials Science and Engineering, Tianjin University; MS received 2 Apr 91]

[Text] Mullite-zirconia composites are studied in the paper. Lower bending strength (σ_f = 236 MPa) and fracture toughness (K_{Ic} = 2.5 MPa-m$^{1/2}$) of pure mullite prepared by wet-chemical method are found. But for mullite-zirconia composite, σ_f (612 MPa) and K_{Ic} (5.1 MPa-m$^{1/2}$) have been greatly increased. The mechanisms of strengthening and toughening by zirconia are thought to be the effect of micro-stress field, zirconia transformation toughening, and second-phase particle dispersion strengthening.

Growth Processes, Characteristics of Polycrystalline Diamond Films and Epitaxial Diamond Films

40100042B Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE CERAMIC SOCIETY] in Chinese Vol 20 No 4, Aug 92 pp 387-392, 386

[English abstract of article by Li Jia, Zhang Zhan, et al. of the Zhengzhou Research Institute for Abrasives and Grinding, Ministry of Machinery and Electronics Industry; MS received 7 Jan 91, revised 3 May 91]

[Text] The growth processes and characteristics of polycrystalline diamond films and epitaxial diamond films by microwave plasma CVD (Chemical Vapor Deposition) method are presented. Polycrystalline diamond films, 20 mm x 20 mm in area and 10 μm thick, on silicon (111) substrates and epitaxial diamond films, 1.0 mm x 1.0 mm in area and 5 μm thick on (100) planes of synthesized single-crystal diamond substrates were prepared, respectively. For the source gases, i.e., CH_3OH, CH_3COCH_3 and H_2, gases of different carbon concentrations (CH_3OH/H_2, CH_3COCH_3/H_2) were used. The quality of diamond films depends on substrate temperature, CH_3OH or CH_3COCH_3 concentration of the source gas and the position of substrates in reaction chamber. The growth and the quality of the epitaxial diamond films are considerably related to crystal orientations of diamond substrates. Different substrate orientations are necessary for different processes. Epitaxial diamond films and polycrystalline diamond grain were obtained on (100), (110) and (111) surfaces of synthesized single-crystal diamond substrates. The crystallinity of polycrystalline diamond films and epitaxial diamond films were examined by scanning electron microscopy (SEM), micro laser Raman spectroscopy and reflection electron diffraction (RED).

Strategic Change in Pharmaceutical Industries

Redirected Focus

92FE0655A Hong Kong LIAOWANG ZHOUKAN [OUTLOOK WEEKLY—OVERSEAS EDITION] in Chinese No 20, 18 May 92 pp 6-7

[Article by Tang Hua [3282 5478]: "Focus of Drug Development in China Shifting From Copying to Innovation"]

[Text] **The focus in new drug research is shifting from copying to innovation. This is a strategic shift that must be achieved during the next 10 years by China's pharmaceutical industry.** To protect intellectual property rights over original drugs and spur this strategic shift, a revised China Drug Patent Law will be implemented. Chinese pharmaceutical circles have accelerated the pace of shifting the focus of drug research and production to innovation.

I. Studying the Historical Causes for the Step

China has abundant microorganisms, Chinese herbal medicines, animals and plants, and other natural resources that provide a broad arena for the creating new drugs by multiple routes including synthetic drugs, natural drugs, biochemical drugs, and so on. Still, innovative drug research that began in the late 1950's has consistently had difficulty in moving forward and China's medicines have been in a state of being dominated by copying for a long time.

Currently, for example, China has 1,152 chemical and pharmaceutical plants and a basically full complement of 24 categories of products such as antipyretic analgesic, anti-infective, anti-carcinogen, drugs for cardiovascular diseases, and other medications. Statistical tables from the State Pharmaceutical Administration show that China itself developed a total of 20 of the 783 types of new drugs produced in China during 1990, equal to just 2.6 percent.

This is the historical cause. Because drugs are special commodities used to prevent and treat diseases, they are closely related to the people's lives and health and have substantial humanitarian significance, so China's implementation of patent protections for pharmaceutical products must be somewhat later and less complete relative to other realms. Patent protection is implemented for the techniques and technologies involved in drug production but the medicines themselves are not protected. For new drugs that have received patent protection in foreign countries, if they are not yet being produced in China and a new drug registration application has been submitted to Chinese public health departments, Chinese enterprises have the right to copy them and can obtain new drug registrations.

For a rather long time, in dealing with the enormous social demand for medical drugs, China's pharmaceutical enterprises and research organizations have been restricted by their economic strengths and technological capabilities of innovation and most of their so-called new drug research has involved copying from foreign countries. In concrete terms, there were two types of copying. One was stock drugs and their preparations already approved for production in foreign countries but which had not yet been included in a national pharmacopeia. The other was stock drugs and their preparations already approved for production in foreign countries that had already been included in a national pharmacopeia. Pharmacological and toxicological research was necessary for both during the copying and they had to undergo animal tests and clinical trials. Compared to creating new drugs, copying involved less risk, small investments, and shorter schedules.

II. Meeting a Pressing Challenge

Among the limited number of new drugs that have been placed onto the domestic market in recent years, one type was created in China and the other type was developed and placed on the market by China itself simply by reviewing abstract reports from foreign countries. An example in the former case is arteannuin and its preparation, remarkably effective for drug- resistant pernicious malaria, and it has received high praise from international medical circles. In the latter case, for dihydroetorphine hydrochloride and its preparation, compared to morphine and others it is the most powerful anaesthetic-analgesic medication with relatively small addictive properties to date, and its birth in China has been considered a "major advance in the history of analgesic research".

As the commodity economy and reform and opening up expand in height and depth, **it is essential that China protect intellectual property rights and implement drug patents. Starting in the mid and late 1980's, the relevant administrative departments did targeted encouragement of research on new drugs.** In 1987 the State Planning Commission and State Science and Technology Commission joined together to establish a new drug research fund to subsidize research on new drugs throughout China. The State Pharmaceutical Administration is responsible for organizing the management of this new drug fund and it has funded 100 research projects in the past 5 years. The relevant officials announced on 17 May 1992 that 10 fund projects will basically complete preclinical trial research by the end of 1992 and it is expected that three new drugs from these fund projects will be on the domestic market by the end of 1995.

Apparently, China now has over 10 scientific research academies and institutes that have a new drug development capability and about 3,000 specialized personnel directly involved in new drug development. There are 10 large and medium-sized state-run pharmaceutical enterprises that have the overall economic and technical strengths for taking on new drug development. For China as a whole, however, a healthy system for our own development of new drugs has not yet been formed.

Starting on 1 January 1993, China will implement a new drug patent law and cannot take a route like the one in copying patented medications. The newest statistics show that the average annual growth rate for drug consumption in China has climbed at 6 to 8 percent. Assuming that Chinese pharmaceutical circles do not accelerate the pace of their own development and rely on purchases of pressure licenses from foreign countries, and calculating at purchases of just 30 product varieties each year, it would take $180 million. Moreover, it is not certain that foreign countries would be willing to transfer several new product varieties with good curative effects. For this reason, the state would also be forced to spend over $100 million to purchase ready-made drugs from foreign countries.

There are several other factors that make the domestic pharmaceutical consumption market situation less than optimistic. Most Chinese-foreign joint investment enterprises that market their products inside China directly "grab" the limelight as independent producers of new drugs and special drugs from their parent companies. These replacement or new "foreign drugs" are marketed at high prices and are in great demand. Some products with only a 5 percent market share obtain over 50 percent of their income from sales from similar categories of drugs. This undoubtedly places enormous competitive pressures on large and medium-sized state-run pharmaceutical plants, so many state-run pharmaceutical plants recognize that now is the time to expend substantial efforts on developing their own new drugs and that getting started early can reverse the current passive situation.

Actually, as soon as a new drug enters the market and is in great demand, the economic benefits it generates are often 10 times to several 10 times higher than the investment. As a result, large pharmaceutical plants in foreign countries see new drug R&D as the basic means of existence and development of their enterprises and often try to place one or two types of new drugs on the market each year. China's large and medium-sized state-run pharmaceutical enterprises are gaining an increasingly powerful feeling about this point and are beginning to hold positive attitudes toward taking the initiative in developing their own new drugs.

III. Establish Our Own Innovation System

China's intentions regarding the issue of implementing patent protections for pharmaceutical products are very clear. They are to move closer to current international methods and accepted practices as quickly as possible to aid further participation in international exchanges and cooperation. Revision and perfection of the original drug patent law has been raised to become the state's order of the day and the relevant administrative departments have now gradually clarified the new train of thought for establishing a system to do their own R&D on new drugs:

Break down departmental and regional boundaries, mobilize the initiative of all areas in China, implement unified plans for new drug R&D, make rational deployments and have a division of labor and cooperation, reduce low-level repetition, make more effective use of manpower, finances, and materials.

Establish a new drug R&D system in which pharmaceutical industry enterprises are the main force and that integrates science, industry, and trade, find rational solutions to investment channels for new drugs, establish an investment system.

Implement combined study of Chinese and Western medicines, integrate Chinese and Western medicine, make full use of our domestic Chinese medicine resource advantages, form low-cost and high-efficiency new drug R&D advantages.

Strengthen R&D in the field of pharmaceutics, exploit the vitality of our existing drug resources, create new types of preparations and new types of medicines with good curative effects, low toxic side-effects, and convenience of use.

Economic inputs should be focused on developing new drugs while at the same time relaxing the legal copying of new international drugs with good curative effects. Focus on medical uses in the R&D process for new drugs, but do not neglect new developments with important value in agriculture, forestry, animal husbandry, fishery, and other areas so that we increase the overall benefits of new drug R&D.

Recently, officials in the State Pharmaceutical Administration indicated that they will try to develop an ability to develop and place on the domestic market 15 types of new drugs each year by the end of the century (including three types of new drugs that will be placed on the international market), and to register three to five new drugs in the industrially developed countries.

Evidently, relevant areas in the state have begun operations. **One thing is that policy guidance and administrative measures are being used to spur integration of existing key scientific research academies and institutes with pharmaceutical industry enterprises, especially enterprise groups, to use group arrangements to develop new drugs.** On 17 May 1992, the State Pharmaceutical Administration, responding to requests for instructions from the State Council and State Science and Technology Commission, decided to select the North China Pharmaceutical Group to serve as a trial point unit in organizing the North China New Drug Preparation and Development Group.

Second, on the basis of unified planning, **establish a group of new drug research centers, specialized laboratories, intermediate testing base areas, and databases that conform to international standards in a planned way in the key new drug R&D system.**

Three, **establish encouragement mechanisms for new drug R&D including the adoption of special preferential policies to encourage investments in new drug R&D,**

encourage scientific research units that develop and patent new drugs, encourage the industrialization of new drug R&D achievements, award personnel who make contributions in new drug research work, and so on.

IV. New Directions for New Drug Research

To make the transition from focusing on copying to innovation in pharmaceutical research and production and reduce our lag behind the developed nations in the area of new drugs as quickly as possible, Chinese pharmaceutical S&T experts are seeking to make technical breakthroughs in the following key areas:

Improving drug production technology and applying computers and other new technologies to attain the objective of optimizing stock drugs and stabilizing technologies to make substantial improvements in product quality and acceptance rates; intensify research on pharmaceutical intermediaries, improve drug production matching levels; do R&D on all types of new types of equipment used in drug preparation including high-pressure, high-temperature, deep cooling, fermentation, catalysis, separation and purification, preparation, energy conservation, "three wastes" [waste water, waste gas, and industrial residues] treatment, and other equipment.

Develop comprehensive technology for preparation. Develop slow release, controlled release, skin absorption, hypodermic implants, mucosal administration, targeted administration, and other new types of preparations and highly effective compound preparations; do R&D on new types of supplementary materials, new techniques, and new packaging materials; gradually strengthen pharmaceutical theoretical research, explore and create more ideal new types of drug administration systems.

Focus on innovative drug research. Work on synthetic drugs, natural medicines, biologically derived drugs, and other types of routes, do R&D on drugs for preventing major diseases; gradually establish several types of drug screening and safety evaluation centers that conform to GLP requirements; undertake research on molecular pharmacology, toxicology, and other specialized types of pharmacology to improve design levels and success rates for innovative drugs.

Reinforce research on application and development of pharmaceutical high technology. Apply modern biotechnology to strengthen research on new drugs and biological preparations, do R&D on monoclonal antibodies, guided drugs, new types of vaccines, active polypeptide drugs, highly effective antibiotics, medicinal plants, medicinal fungi, and so on; focus on developing key developmental technology in pharmaceutical biology.

Raise research and production technology levels for Chinese medicines. Focus on basic theory and traditional theory for Chinese medicines and research on the pharmacology of Chinese medicines and chemistry of Chinese medicines; apply modern pharmacological, plant chemistry, and other measures to describe the mechanisms of action for Chinese medicines, focus on developing new drugs for common dangerous and acute diseases; apply bioengineering technology to develop substitute products or new product varieties for endangered Chinese medicines; reinforce research on roasting, baking, and simmering techniques and preparation techniques for Chinese medicines and make Chinese medicine preparation and production attain GMP (international drug production and management regulations) requirements.

The challenges and crises facing Chinese pharmaceutical circles are there and opportunities coexist with risks. Everything is urgent and everything is being carried out with orderly deployments.

Modern S&T Application Emphasized

92FE0655B Hong Kong LIAOWANG ZHOUKAN [OUTLOOK WEEKLY—OVERSEAS EDITION] in Chinese No 20, 18 May 92 pp 8-9

[Article by Dai Qingjun [2071 1987 7486]: "Rely on Modern Science and Technology, Develop China's Pharmaceutical Industry"]

[Text]

I. Ten Years of Development, Many Accomplishments

During the 1980's, pharmaceutics in China entered a gold era in its development history and laid a foundation for developing toward even higher levels. At present, the industry as a whole has 285 large and medium-sized enterprises with a value of output of 40 billion yuan in 1991. It has now become an independent economic industry that integrates industry and commerce, is fully matched up, and has a substantial scale. During the past several years, China has relied on S&T progress to develop the nation's pharmaceutical industry and made significant advances in the following six areas:

A. Substantial development of S&T forces that have now formed a specialized S&T staff of substantial size and rather high quality.

The number of independent scientific research academies (institutes) in Mainland China's pharmaceutical system has now grown to 56 and they have over 5,500 specialized S&T personnel. Moreover, most of the large and medium-sized enterprises in the pharmaceutical industry have established plant-run research institutes (or research offices). The system as a whole has a total of 158,000 S&T personnel of all categories, equal to 15 percent of the total number of employees in the entire system, and they have now formed a specialized S&T staff with substantial numbers and a relatively full complement of all types of disciplines.

B. Major achievements were made in attacks on key state S&T problems during the Seventh 5-Year Plan and pharmaceutical S&T work developed in a comprehensive way.

During the state's Seventh 5-Year Plan (1986-1990), nearly 3,000 S&T personnel in over 70 scientific research academies and institutes, institutions of higher education, and enterprises participated in attacks on key problems. After more than 4 years of cooperative efforts, they made over 100 S&T achievements, including 26 that attained international levels and 39 that attained advanced levels in China. Eight items received state patents. They have developed 10 types of new antibiotic replacement products with relatively high international evaluations and 22 new medicinal products with good curative effects and low toxicity. They completed reform of production technology for several important products, reduced our lag behind advanced international levels, and strengthened our competitiveness. They developed over 20 types of controlled release, skin penetration, targeted, and other new types of preparations and several types of new adjuvants that have played a major role in spurring a rapid transformation of the backward situation in the pharmaceutical industry. They have also successfully developed X-ray imaging amplifiers and medium-frequency X-ray generation devices, which are key components in X-ray diagnostic equipment, as well as 12 types of assembled products including a new generation of ultrasound diagnostic devices, multifunction electrocardial monitoring systems, and so on and 25 types of key matching components. These products have now attained international levels for similar products during the 1980's. Application and extension of computer technology has now moved from the administrative realm to the production control realm. Preliminary achievements have been made in R&D on high and new technologies such as biotechnology, etc. Because these achievements were made, over 40 new medicinal products and therapeutic appliances have been placed on the market and are being produced in batch quantities, and there have been significant improvements in production technology levels for major product varieties that have further improved the product mix in the pharmaceutical industry and produced rather good social and economic benefits. Preliminary statistics indicate that they are generating at least 1.5 billion yuan in value of output and 300 to 400 million yuan in profits and taxes each year. These achievements have laid a foundation for development of the pharmaceutical industry during the 1990's.

C. A substantial increase in investments in technical progress in the pharmaceutical industry.

During the past decade, state-run pharmaceutical enterprises have universally established a guiding ideology of seeking to exist and develop in competition and relying on technical progress to improve their competitive abilities. Along with reinforcing technical upgrading, they also recently decided to set aside 1 to 3 percent from their volume of sales for use in technical upgrading. This item alone has increased enterprise investments in technical upgrading from 400 million yuan to 1.2 billion yuan and effectively spurred technical upgrading in enterprises.

D. Significant advances in technical progress in enterprises

Since the mid-1980's, with the substantial increases in capital invested in technical upgrading, attacks on key S&T problems and technology development, and especially intensive reform in the S&T system, have accelerated the process of converting S&T achievements into forces of production, and several S&T achievements have been converted into commodities, which has in turn spurred technical progress in enterprises.

E. Significant improvement in enterprise product quality

Technical progress is a guarantee of stable improvement in product quality in enterprises. All of China's primary pharmaceutical products have now attained or surpassed standards in the newest international pharmacopeia. For example, all of the Northeast China Central Pharmaceutical Plant's 16 primary products have attained or surpassed standards in the newest international pharmacopeia and have been certified as "employing advanced international standards", and 22 of its export products have received exemption from inspections by foreign trade departments for 26 successive years. During the Seventh 5-Year Plan, the state's quality sampling certification rate for 153 groups of 51 types of products from this plant was 100 percent.

F. Participation in international exchanges, establishing Chinese-foreign joint investment and cooperative enterprises.

During the 10-plus years of reform and opening up, China's pharmaceutical industry has actively participated in international exchanges and cooperation. According to incomplete statistics, China has now established over 100 "three capital sources" [foreign capital, overseas Chinese capital, and Hong Kong and Macao capital] pharmaceutical enterprises in China with 18 countries and regions. The number of "three capital sources" pharmaceutical enterprises we have established in foreign countries now exceeds 20.

China has imported production techniques and technologies for cephazoline, cephahydroxyhydrogen, and 7-ADCA, as well as release-controlled pharmaceutics, micropills, and so on. We have imported hard capsula and soft capsula production lines, pulvis and freeze-dried pulvis production lines, high-speed tablet machines, one-step granulators, suppository making equipment, capsule filling equipment, pure aspirin production equipment, and other types of advanced equipment.

In addition, China is also exporting VC 2-step new fermentation technology, VB_6 new synthesis technology,

streptomycin bacterial strains and production technology, inulinoside production technology, and arteannuin production technology, and so on. We are exporting water injection and infusion making production equipment, and production technology for aspirin, acetaminophen, cimetidin, analgin, and other injection and tablet preparations.

II. Three Lags in the S&T Area

Compared to the developed nations, China's pharmaceutical industry lags in several ways in the area of science and technology:

1. Our new drug innovation capabilities are still relatively weak. This is prominently manifested in two areas: insufficient personnel involved in creating drugs and incomplete advanced experimental instruments and equipment.

2. Among the products now being produced, technical levels for a substantial number of products still lag substantially behind advanced international levels. Further improvements are needed in the quality and reliability of medical instruments and equipment.

3. In high-S&T realms, China's pharmaceutical industry is still in the initial stages and a considerable distance remains for industrialization. The lag is even greater compared to advanced international levels.

III. Enter Markets, Engage in Competition

The fundamental tasks for China's pharmaceutical S&T during the Eighth 5-Year Plan (1991-1995) and the next 10 years are:

1) Serve the achievement of medical treatment, health, recovery, and family planning for all the people of China.

2) Serve improvement in the international competitiveness of our pharmaceutical industry.

One very important thing among them is to make a major effort in the area of the chemical pharmaceutical industry on selective research for innovative drugs and participate in patented drug competition; make a major effort at preparation R&D, improve the competitive capabilities of our preparations; make a major effort to strengthen R&D on scale production and engineering technology and make our non-patented drugs more competitive; make a major effort to strengthen R&D on biotechnology and participate in competition in high and new-tech fields.

The signing of the "Sino-American Memorandum of Understanding on Intellectual Property" and the revision and implementation of the part of the Chinese Patent Law concerning medicines are indications that the development of China's pharmaceutical industry has entered a new historical stage. In this new stage, China faces serious challenges as well as new development opportunities. This requires that China's pharmaceutical industry establish a concept of the two large international and domestic markets, that it establish a concept of competition, and that it advance and develop in fierce competition. To achieve this point, we must rely on S&T progress. That is the only way.

Shenyang Pharmacy College

92FE0655C Hong Kong LIAOWANG ZHOUKAN [OUTLOOK WEEKLY—OVERSEAS EDITION] in Chinese No 20, 18 May 92 pp 9-10

[Article by Jiang Min [1203 2404]: "Shenyang Pharmacy College: Actively Developing, Creating, and Extending New Drug Achievements"]

[Text] There is a university known near and far located on the banks of the Hun He in Shenyang City in northeast China. It is the "cradle" where China's medical personnel are trained: Shenyang Pharmacy College. For the past several years, a large group of educational and scientific research workers at the college have walked out of the tall buildings and deep courtyards and explored new routes for mutual promotion of education, scientific research, and production, and participated in promoting the course of the commercialization, industrialization, and internationalization of medical achievements to achieve a strategic shift in the development of medicines in China from copying to innovation.

I. Countless Scientific Research Achievements

The predecessor of Shenyang Pharmacy College was the China Worker Peasant Red Army Health School founded in 1931. It is now one of two comprehensive pharmacy colleges of higher education in China under the jurisdiction of the State Pharmaceutical Administration. The school's campus covers an area of 22.6 hectares and it has 130,000 square meters of school buildings.

This college has four departments for pharmacy, Chinese medicine, drug preparation, and administration and engineering, and nine specializations in pharmacy, drug preparation, drug analysis, Chinese medicine, Chinese medicinal drug preparation, chemical drug preparation, microbiological drug preparation, and so on. Its has three disciplines authorized to award doctoral degrees and six disciplines authorized to award Master's degrees, and it has a total of 65 doctoral and masters' advisory professors. In 1991 it received approval from the relevant departments of the state to establish a post-doctoral circulation station for the field of pharmacy. Since its establishment, the college has trained several 10,000 advanced pharmacy and drug preparation personnel for the state.

According to information provided by officials at the college, since the 1980's Shenyang Pharmacy College has shifted from a purely "teaching type" to a "combined production and teaching type" that integrates education, scientific research, and production. It has established a Drug Institute, Higher Education Institute, Testing Center, Computing Center, and Electronic Education

Center; its educational and scientific research base area—a college-run pharmaceutical plant—has a large modern drug preparation building that produces batch quantities of various type of medicinal products according to social demand.

Through continual exploration, Shenyang Pharmacy College has gradually formed a scientific research orientation focused on new drug research for antineoplastic, anti-inflammatory, antimicrobial, antiviral, anti-aging, and prevention of cardiovascular diseases that uses industrial pharmacology, physical pharmacology, and organic pharmacology as a foundation for undertaking research on new technologies, new supplementary materials, new preparations, and new product varieties; for carrying out systematic research on the active components of Chinese medicines and natural medicines; and for conducting research on new drug synthesis, medicinal product quality control, bacterial strain selection and cultivation, and new techniques and new equipment. In addition, it also conducts research on the related basic theory.

At Shenyang Pharmacy College, I saw this common university in recent years assume responsibility for state attacks on key S&T problems and over 50 projects from the natural science fund, new drug fund, State Pharmaceutical Administration, ministries, province, and city and over 30 horizontal development and cooperation projects with enterprises. Its volume of technology trade exchanges in 1991 alone exceeded 2.2 million yuan. In the past 10-plus years, the college's scientific research achievements have received 66 S&T progress awards from the state, province, and city, it has applied for six patents, and it has received 10 new drug certifications that include several research achievements in pharmacology, drug chemistry, and drug analytical chemistry that have had a substantial impact in China and foreign countries. Several achievements were inspected and accepted and placed into operation during the same year and produced significant economic and social benefits.

The college began participating in systematic research on ginseng relatively early. During the mid-1980's it completed a project on red ginseng processing technology and quality standards and it recently also completed projects on the relationship of the chemical components of red ginseng to its anticarcinogenic and antiarrhythmic effectiveness, and it studied 12 types of ginsenoside for the first time in the world and made the first discovery of new regularities of the structural effectiveness relationships of two compounds and three types of pioneering compounds that laid the foundation for the world's first ginseng monomer.

II. Extending Drug Achievements

At Shenyang Pharmacy College, 80 percent of its achievements are now being converted into commodities.

Pharmacy is a national-level key discipline at this college. Professor Zhang Ruhua [1728 3067 5478], who has the responsibility of a doctoral advisor here, took on a state-level project to attack a key problem in 1986: research on modified starches. He and his assistants attacked and overcame numerous difficulties and completed the supplementary material preparation project 2 years ahead of schedule, which also spread rapidly to use in nearly 300 pharmaceutical plants in over 20 provinces and municipalities in China. The medicines produced by pharmaceutical plants that used the modified starches can be pressed into tablets directly, which reduces work procedures and conserves investments in plant buildings and equipment, with extremely significant economic benefits.

This 66 year-old elderly professor is very concerned with preparation technology for children's medications. For the past several years he has buried himself in research on intestinal dissolving medicines, tasteless microcapsules, and so on and received three patents, including one for his tasteless microcapsule technology that was purchased by the Guiyang's Shenqi Pharmaceutical Plant, which signed a long-term cooperation contract.

Professor Shen Jianmin [3088 1696 3046], who began teaching at the pharmacy college in the early 1950's, became avidly involved in research on drug synthesis in the 1960's, and reform and opening up has added vitality to his research office. The anti-digestive tract ulcer drug he developed—anti-peptic ulcer (famotiding)—was the first in China to receive a new drug registration, and he has been cooperating with Shandong's Qingdao Pharmaceutical Plant for the past 3 years, which earned the enterprise over 7 million yuan during the trial production period. He also developed an anti-gastric ulcer drug—aomeilazuo—that has been transferred to the Jinzhou No 1 Pharmaceutical Plant.

III. The Honor Is in Innovation

"In R&D on new medical technology, new products, and participation in international market competition, the honor is in innovation". Shenyang Pharmacy College vice president Yu Guanghui [0060 1639 1979] told me that "if we do not take the route of industrializing new medical technology with Chinese characteristics, achieving a strategic shift from copying to innovation in the development of new drug varieties is merely empty talk".

As the "transportation source" that ships new technologies, new achievements, and new products to pharmaceutical plants throughout China, they have proposed development ideas for the future.

One is cooperative development with large pharmaceutical enterprises and groups in China or establishing new drug development joint bodies to allow S&T to grow into enterprises and implement mutual supplementation of advantages, mutual benefit, and mutual promotion and glory. They are now negotiating arrangements for cooperative development of new medicines with the Northeast China Pharmaceutical Group and plan to conduct research on anticancer drugs.

The second is using the college's drug synthesis, natural drug chemical synthesis, and other advantages, and undertaking college-to-college cooperation with universities in foreign countries, with each sending students to jointly undertake new drug research and make joint applications for patents.

Now, the college has undertaken research on "qiweibai"-mycin with Japan's Kitasato Research Institute; it is doing R&D on ginseng, fleece-flower root, and other Chinese medicines with Japan's International Natural Medicine Society; it is cooperating on developing new drug products with Japan's Toshiba Medical Industry Co., Ltd.; it is conducting research on Chinese proprietary drug model differentiation technology with Hong Kong's Chinese Language University; it is cooperating with the University of Pittsburgh in the United States to develop selection of new anticarcinogenic and anti-inflammatory drugs and they have made joint patent applications in the United States. Professor Chen Yingjie [7115 5391 0267] in the Department of Chinese Medicine is working with Berlin Free University in Germany to conduct "research on the structural effectiveness relationships in decarcenogenesis in the human body" and they have made significant advances.

Third, they are implementing multidisciplinary and multispecialization cooperation within the school for integrated attacks on key problems and are striving to create one to three new categories of drugs and to receive 10 to 15 state new drug registrations by the year 2000.

Apparently, preliminary achievements have been seen from the "China Young People's Scientific Research and Development Startup Fund" and "Returned Students and Personnel Scientific Research and Development Fund" the college has established. Young professor Chen Fujun [7115 4395 0689] returned from studying in Japan and applied to the college for "research on the effective components and pharmacology of action of the antidiabetic Chinese medicine with insulin function from mulberry leaf" for startup funds. With the assistance of the college, this project has made major breakthroughs and it has been included as a State Pharmaceutical Administration Young Person's New Drug Research Fund project. After receiving scientific research and development startup funds, young professors Wang Ying [3769 5391] and Liu Xue [0491 1331] completed "Strategic Research on New Drug Development in China" and presented their paper at the First China Science Association Young People's Academic Yearly Meeting.

The college has also established new drug fund interest-free loans to encourage middle-aged and young teaching and scientific research personnel who have created new drugs to produce more achievements and has enabled superior quality personnel to reveal their talents.

According to arrangements and deployments made by the State Pharmaceutical Administration, Shenyang Pharmacy College is now actively applying for and preparing to establish a drug preparation engineering research center, elderly spiritual disease drug selection center, northeast China special toxicology experiment center, microbiological pharmaceutical base area, and so on.

North China Pharmaceutical Plant

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[Article by Wang Hongxing [3769 3163 5281] and Wang Yuqing [3769 3768 3237]: "Establishing the First Antibiotic Base Area"]

[Text] China is now establishing its first new drug development group headed by the North China Pharmaceutical Plant, which is very well-known in Chinese medical circles. This large integrated drug production enterprise located at Shijiazhuang City on the North China Plain mainly produces antibiotics but also produces starches, glucose, organic solvents, biochemical preparations, and glass products used in medicine. It is China's largest antibiotic stock drug production base area at the present time.

Not long ago, Lu Weichuan [0712 3262 1557], first assistant plant manager and chief engineer at the North China Pharmaceutical Plant, said when receiving visitors that during the past several years they have established and perfected operational mechanisms in their enterprise for relying on S&T progress, using S&T as a vanguard, and focusing on creating superior products in conjunction with developing new products in taking the route of quality and benefits-type development. Now, the plant is producing nearly 2,700 tons of antibiotics a year and has an annual gross value of industrial output in excess of 710 million yuan and actual profits and taxes of more than 200 million yuan.

I. Basing on the Market, Quality Assurance and Superior Innovation

How can "North China Brand" keep its product sales from sagging and establish a winning position in the domestic market? Plant manager Chen Xianfeng [7115 6343 0023] said that North China Pharmaceutical Plant had only one choice, there was no other way. It was to take aim at advanced international levels, focus on creating superior old products, continually raise product quality grades, use product quality advantages to win over users, and corner the market.

North China Pharmaceutical Plant is an old enterprise and some of its products continued using old bacterial strains, old techniques, and old equipment for a long time, which caused production levels to stagnate for 10 years. Starting in 1987, the entire plant carried out wide-ranging equipment upgrading that raised the equipment renewal rate to more than 50 percent, and equipment at international levels of the late 1980's and early 1990's accounts for more than 25 percent. They also

invested over 3 million yuan to import a VS-300 minicomputer from the Wang Company in the United States and established a computing center. They also developed 15 subsystems for quality, equipment, education, S&T archives, input/output, and so on and achieved microcomputer control of the fermentation process. In addition, they imported eight preparation dividing and loading flow lines at advanced international levels from Germany, Holland, and Italy. They used extension and application of new technologies, new techniques, and new bacterial strains to make a substantial increase in product quality, fermentation levels, raw materials consumption, and other primary technical economics indices.

Exports of "North China Brand" products account for more than 90 percent of China's streptomycin sulfate and it received a state superior silver medal award in 1982. All of the product quality indices are higher than international standards and it has received substantial attention from foreign businessmen. One foreign guest contracts for the sale of 100 tons a year.

North China Pharmaceutical Plant is not satisfied with organizing production according to standards in our national pharmacopeia. It long ago organized production of 53 products according to enterprise internal control standards that are higher than legally-stipulated standards, and they formulated internal control standards for 14 items that are higher than state grade 1 enterprises and 26 items that are higher than pharmacopeia in foreign countries. The plant now has 16 product types that have attained "dual adoption" permits for modern international standards and advanced foreign standards. The state superior silver medal lincomycin and famous brand terramycin it exports passed inspection by the FDA in the United States on the first try and received a special permit for the international market.

Raising quality grades requires that management standards and technical standards be raised simultaneously. This plant has used implementation of comprehensive quality management as the center and began with reorganization and comprehensive standardization of management in establishing an omnidirectional quality assurance system in the enterprise. For the past several years, the quality stabilization and improvement rate and the state's supervisory market sample specifications conformity rate of "North China Brand" products have both been 100 percent.

During the mid-1980's, North China Pharmaceutical Plant began running an employees' university, political school, and education center, it established a three-level training network at the plant, workshop, and group levels, and the coverage rate for training has surpassed 80 percent. Nearly 1,000 group leaders have received training in group quality management, labor management, work procedure management, and other specialized knowledge. The training has substantially increased the quality consciousness of all personnel. The 10,000 employees suggest 5,000 to 6,000 rationalization proposals each year and over 600 "QC groups" are spread throughout the plant. They have attacked one quality problem after another and made several new records and new achievements.

II. Developing New Products, Attacking Semi-Synthetic Antibiotics

When North China Pharmaceutical Plant went into operation at the end of the 1950's, it brought to an end the situation of relying on imports of streptomycin and the Chinese people began producing large amounts of antibiotics on their own. After more than 30 years, North China Pharmaceutical Plant has proposed a new goal of struggle: using the time of two 5-year plans to end the situation of relying on imports of semi-synthetic antibiotics.

For more than 30 years, North China Pharmaceutical Plant has relied on its own technical forces to develop new product varieties and has increased the number of products from a total of five types when it was placed into operation to more than 90 types, including antitumor medicines like bleomycin, pingyang-mycin, daunomycin, lusomycin, and others and anti-infective antibiotics like lincomycin, clindamycin, demethylvancomycin, and others, all of which were successfully developed for the first time in China. It has developed heliomycin, clindamycin phosphate ester and fatty acid synthetase inhibitors, and other products. Some have been successfully placed into operation and breakthrough-type advances have been made with others. The successful development of these products has opened up broad prospects for the production of anti-infective drugs and brought glad tidings for the prevention of cardiovascular diseases in elderly people. At the same time, they have also brought excellent economic benefits to the enterprise.

To produce a new generation of antibiotics with better curative effects that are urgently needed by the ill, North China Pharmaceutical Plant formulated the goal of struggle a few years ago of "using penicillin as the dragon's head, using high and new technology as the means, and using energy conservation, reduced consumption, and improvement of economic benefits as the center to develop a series of semi-synthetic antibiotic products". In the mid-1980's decision makers at the plant began looking toward work to develop semi-synthetic antibiotics and they have now placed into batch production cephalosporin, ampicillin, clindamycin, anmiejun, and others, but they have not yet formed a scale and they are far from capable of meeting market demand. Most of the Xianfeng-1 (cephalothin) to Xianfeng-5 (cephazolin) and other cephalosporin series medicines on the domestic market at present are foreign semi-synthetic antibiotics and they cost a great deal of foreign exchange each year. As China's antibiotic production base area, North China Pharmaceutical Plant felt its sense of responsibility and has the capability of

carrying out semi-synthetic antibiotic R&D and production, and it accelerated the pace of R&D during the late 1980's.

In the large scientific research center building at the plant, scientific research personnel are also advancing toward high biotechnology and genetic engineering drugs, and they are now conducting research on growth factors, interferon, and monoclonal antibodies. They are also developing cellular engineering drugs for treatment of cerebral blood vessels and they are developing antimetabolites, fatty acid synthetase inhibitors and vaccine inhibitors for regulating human metabolic processes, and so on.

III. Establishing Operational Mechanisms for Relying on S&T Progress

Establishing a plant-run scientific research institute, importing competitive mechanisms, reinforcing horizontal cooperation, and establishing personnel banks are the four main characteristics of North China Pharmaceutical Plant's promotion of S&T progress.

In the late 1980's North China Pharmaceutical Plant invested over 8 million yuan to build an 11,000 square meter scientific research building for a plant- run Antibiotics Institute. It also spent over $1 million to purchase 10 pieces of equipment including fully automatic fermentation tanks, freezing dryers, centrifuges, and so on from foreign countries. They are also outfitted with 37 pieces of imported high efficiency liquid phase chromatographs, ultraviolet spectrophotometers, electronic balances, automatic titer assay, and other advanced inspection instruments. In the past several years, scientific research expenditures at the Antibiotics Institute have averaged over 3.4 million yuan per year. The instrument has also established under it nine research offices for information, genetic cultivation, new antibiotics, fermentation engineering, chemistry, synthesis, pharmacology, instruments and analysis, and biochemical analysis. Whether in terms of scale and personnel or of instruments and equipment, the institute is the leader among China's pharmaceutical enterprises. After a visit to the plant, professor Hopewood of the English Royal Society's China Exchange Commission and Japan's Kitasato University Research Institute director Toshi Oharu said: "Your institute has left us with a profound impression". The main scientific research tasks of the Antibiotics Institute mainly involve developing new products with some additional improvement in production levels. During the past several years, they have made enormous contributions to improving output and product quality and economic benefits, and have also developed over 10 new product varieties including amphotericin B, daunomycin, demethylvancomycin, cephalosporin, and others. They have also done R&D work in cellular engineering, genetic engineering, and other high biotechnology fields with gratifying progress that has increased the "reserve strengths" for enterprise development.

A topic competition contractual responsibility system and the signing of contracts for projects to attack important key problems implemented by North China Pharmaceutical Plant have induced all of the plant's S&T workers to dedicate themselves to scientific research work, foster their individual intellect and skills, and contribute their forces to the completion of every project to attack key problems and the development of every new product. They have also organized leading cadres, S&T personnel, and workers to participate in "three integrations" on-site key problem attack groups to promote the extension and application of new techniques and new technologies. For example, they did continual R&D to achieve 20 computer controlled production process projects with yearly economic benefits in excess of 30 million yuan. Now, they have applied computer technology in almost all of the plant's main antibiotic fermentation processes and have achieved process control. The extension and application of new techniques and new technologies has spurred the development of production and raised technical levels up to a new level.

During the scientific research development and technical upgrading processes, North China Pharmaceutical Plant has integrated independent development with cooperative development in signing several types of cooperation contracts with a large number of institutions of higher education, specialized scientific research academies (institutes), and military industry units for joint R&D and absorption and digestion of advanced technology from foreign countries, with gratifying achievements.

In a situation a few years ago of extreme capital shortages, North China Pharmaceutical Plant invested over 2 million yuan to build an employee education center building with over 20 laboratories for chemistry, microbiology, physics, electrical engineering, and so on and research offices for antibiotic fermentation, an extraction and purification technology simulation classroom, and so on. They also purchased cameras, compilers, video recorders, projectors, large screen projection televisions, and other modern teaching equipment that created favorable conditions for improving the educational quality of the employee university, television university, and technical school. Based on the production characteristics of the chemical and pharmaceutical industries, they have integrated with actual needs at all types of posts and production and undertaken applied education in the various types of work in all disciplines and specializations and on-the-job training. They have also organized intensive study classes for group leaders, enterprise management modernization, principles and objectives, comprehensive quality management, network technology, computer knowledge, and other levels. They also encourage employees to study skills and have invited experts from foreign countries to come to the plant to teach spoken English classes. The plant now has eight S&T personnel doing research and studying in scientific research units in Japan, the United States, and England. The plant has establish a long-term training

base area at the Kitasato Research Institute in Tokyo, Japan and sends several personnel there each year for scientific research, advanced study, and conducting academic exchanges. Multiple channels and multiple forms of education and training have been used to train a large group of technical professionals and skilled administrative personnel for the enterprise.

CAS Shanghai Pharmaceutical Institute Developing New Drugs

92FE0655E Shanghai WEN HUI BAO in Chinese 13 May 92 p 3

[Article by reporters Zhou Chen [0719 2525] and Wang Lin [3769 3829]: "The Chinese Academy of Sciences Shanghai Pharmaceutical Institute Is Working To Develop New Drugs—54 of Its 140-Plus Scientific Research Achievements Completed in Recent Years Have Been Placed Into Production, Making It the Research Institute That Has Created the Largest Number of New Drugs"]

[Text] The Chinese Academy of Sciences [CAS] Shanghai Pharmaceutical Institute is working on new drug R&D. It has now placed 54 of the 140 scientific research achievements it has completed in the past several years into production and completed over 30 types of new drugs, over 10 of which have been included in China's pharmacopeia, making it the research unit with the highest new drug research levels and largest number of new drugs created in China.

Breakthroughs and important advances have been made in several basic research topics at the institute. A long-term research project led by professor Chi Zhiqiang [3069 1807 1730] was the first to create the powerfully effective analgesic methylol fentanyl. Research on the mechanisms of its action has confirmed that it has small toxic side-effects on the respiratory system and cardiovascular system and has applications prospects in external analgesia. Clinical pre-studies are now actively being done to accelerate its development into a new drug for clinical uses. This achievement received a National Natural Sciences second-place award in 1991.

A project group led by professor Jin Guozhang [6855 0948 4545] has employed modern science and technology to conduct research on brain region locations—animal behavior—transmitter levels—drug three-dimensional structure. They have opened up a new research direction for new types of central nervous system depressants and have made a series of achievements. They have clarified that materials similar to L-tetrahydroprotoberberine analogue are a new type of blocker for dopamine receptors and they have confirmed its therapeutic effects on migraine, restless syndrome, and primary tremors. This achievement received a National Natural Sciences third-place award in 1991.

Several new drugs created for the first time in China by this institute have also received international recognition. They discovered that sodium dimercaptosuccinate (DMS) has a detoxification action on many metals and it has now been made into easily administered dimercaptosuccinate tablet preparations. Repeated experiments by many countries in Europe and the United States have confirmed that dimercaptosuccinic acid is the most effective antidote at the present time for lead, arsenic, mercury, and other metallic toxins. After long-term testing by the United States Food and Drug Administration (FDA), this drug was approved for clinical use in the United States. This is the first new drug developed in China that has been licensed in the United States. This achievement received a National S&T Progress second-place award in 1991.

Establishment of Domestic New Drug Development System Urged

92FE0655F Shanghai JIEFANG RIBAO in Chinese 27 Apr 92 p 3

[Article by reporter Xu Chengsi [1776 2052 3320]: "Ministry of Public Health Scientific Research Achievement Symposium Proposes Establishing an Integral System in China for Developing Its Own New Drugs To Promote the Commercialization, Industrialization, and Internationalization of High and New Technology in Medicine and Public Health"]

[Text] The Ministry of Public Health's Second National Medicine and Public Health Scientific Research Achievement Extension and Application Work Symposium was held at Shanghai Medical University on 26 April 1992. In his speech at the meeting, minister Chen Minzhang [7115 2404 4545] of the Ministry of Public Health stressed that "all scientific research academies and institutes and institutions of higher education in the public health system must place S&T development work in a position of importance like that for medicine, education, and research to promote the commercialization, industrialization, and internationalization of high and new technology in medicine and public health".

After the signing of the "Memorandum of Understanding on Protecting Intellectual Property RIghts" between China and the United States on 16 January 1992, the development of China's medical and public health industry faces an even more serious situation. About 97 percent of Western medicines are copied drugs that have international production licenses, and an average of about $6 million must be spent on each product variety. For this reason, accelerating the transition from "copying" to "self development and innovation" in China's medical industry and establishing an integral system for China's "self development and innovation" of new drugs cannot be delayed.

According to preliminary statistics, China's medical and public health system has now established 89 S&T enterprises. On 26 April 1992, Minister Chen Minzhang called on all units with S&T forces to strive to develop one or two "fist" products.

Apparently, to encourage S&T development, the Ministry of Public Health has now formulated the relevant preferential policies: extension and application projects will account for about 10 percent of S&T progress awards; technology market Golden Bridge Awards will be established to commend advanced collectives and individuals involved in S&T development; the accomplishments made in S&T development and in production management and administration will be the primary basis for appraisal of job titles and duties of S&T personnel and administrative personnel in S&T enterprises, and so on.

Hastening Independent Pharmaceutical, Special Chemical R&D

93FE0054D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 8 Aug 92 p 1

[Article by Hui Yongzheng [1920 3057 2973] and Deng Nan [6772 2809]: "Hastening Transformation Toward Independent R&D of Pharmaceutical and Special-Purpose Chemical Products"]

[Text] Toward the turn of the century, competition in economic technologies will become intense, and revolution in new science and technology (S&T) will roll on with full force. S&T is valued increasingly in social production. Global economic competition coupled with international power competition is more and more being demonstrated as an S&T contest. The uniformity of intellectual property rights is the new world trend. In order to meet this historical demand, China has decided to hasten legislation regarding intellectual property rights to expand the range of protection so that the Chinese legal system will close ranks with the international standards. This is a great step for legalization in socialization. It is also an important link to deepen reform and expand the policy of opening up.

Undoubtedly, the legislation regarding China's intellectual property rights will be significantly influenced by the international community. However, in the process of speeding up the Chinese intellectual property rights system to meet international standards, the primary consideration is the objective need for the modernization of Chinese socialism. The important changes of Chinese patent law is to grant patent protection in pharmaceuticals and chemicals, as well as foods, drinks, and condiments. Thus the patent protection covers almost the entire technical field. By so doing, a severe challenge as well as an important opportunity is presented to Chinese industry's comparatively weak research and development (R&D). It demands that China deepen the reform of synchronizing S&T and the economy, to fully develop S&T superiority, and to accelerate the development of independent exploration. This article discusses the promotion of transformation of pharmaceutical and chemical industries toward independent development.

I. Establish the Transformation Strategy of Utilizing S&T To Promote Pharmaceutical and Special-Purpose Chemical Industries

Pharmaceutical and special-purpose chemical product (P&SCP) industries are highly technology-intensive and strongly dependent on S&T. However, for a long period of time, China has relied on copying. A large portion of these products are imitations, and most of them are made according to expired foreign patents. Copying causes technology and management to seriously fall behind. To achieve the goal of transformation, these industries will undergo a period of difficult times. After the patent protection law for P&SCP is enforced in 1993, new foreign inventions can apply for patents in China. According to conventional practice, imitation of the patented products is prohibited within 7 to 10 years after their introduction in the market. In other words, in less than 10 years, China must narrow the existing 20-year gap between China and the developed nations in order to achieve the basic goal of creative production. According to the China-U.S. Memorandum on the protection of intellectual property rights, all the pharmaceutical and the agricultural chemistry products with U.S. patents granted during the period of 1 January 1986 to 1 January 1993 can apply for the administrative protection of the Chinese government before they enter the Chinese market. At present, the European Community and Japan are also making similar demands. Hence, even in the limited transformation transition period, the copying and utilizing of existing foreign patents are considerably restricted. Understandably, Chinese P&SCP face a grave situation.

On the other hand, China possesses certain conditions to rapidly materialize the transformation. Since the founding of the People's Republic over 40 years ago, a considerable production base for pharmaceutical and chemical engineering has been established. For example, in the pharmaceutical field, China has 1,152 chemical pharmaceutical factories which can produce basically all the 24 major categories of pharmaceuticals. China has tens of thousands of Chinese traditional medicine resources which makes it a large pharmaceutical resource country. Even more important, China already has a scientist and technologist contingent of considerable scope and standard. China has over 10 research institutes able to create new medicines. There are more than 3,000 specialists directly engaged in developing new medicines. A group of new medicines with good market potential have been formulated. At present, the crucial problems are to revise the basic development strategy, and to fully develop the superiority of the S&T integration so that "S&T is the first productive force" and is truly liberated. This is not only the mission of the pharmaceutical and the chemical engineering professionals, but also the mission of both the economic front and the S&T front. China's S&T workers must make the promotion of the transformation an important mission of the new era, establish a new operation system for the

P&SCP, and accelerate the commercialization, industrialization, and internationalization of the S&T accomplishments. Based on the above important elements of deepening the reform of S&T, a S&T industry with superior international competitiveness is then established.

II. Establish a Modern Research and Development System for P&SCP

For the successful transformation, it is necessary to establish step-by-step a vital research and development (R&D) system which can bring about cooperation and promotion among all types of research, developments, experiments, and production.

First: There must be an industrial pillar formed by an enterprise conglomerate whose primary function is R&D. To organize an enterprise conglomerate, China must consider its overall strength in science and research, and the development and production forces; break the barriers among regions, departments, trades, and ownership boundaries; and then select and organize what is superior. The enterprise conglomerate will establish a modernized technological development organization to create a stronger R&D capacity, as well as practice the integration of research, exploitation, experiment, production, and management. Through contractual research, cooperative exploitation, investment share participation, annexation, and other various formats, the integration among conglomerates, research institutes, as well as colleges and universities is promoted. The Chinese government policy and investment encourage and guide the R&D institutes to participate in the enterprise conglomerates.

Under the current conditions, the Chinese government should also guide and support a few scientific research institutes with great R&D potential to gradually develop into precursors of enterprises or enterprise conglomerates. To achieve this goal, the government could establish a few highly specialized engineering-technology centers, or encourage the scientific research institutes together with the institutes of higher education taking with them their research topics and achievements to the high, new-tech development districts to create or co-establish high, new-tech enterprises. To this end, China should support the establishment of basic conditions for interim experimentation, standards, measurements, and testing; and moreover should urge the development of intermediate organizations for information, intelligence, and consultation so that the innovative capacities and standards can be improved as rapidly as possible.

Second: A group of R&D centers of international standard should be established. In principle, the centers which provide services for products (including the R&D centers equipped as bases for intermediate testing) should join the enterprise conglomerates, and should be planned and organized by the conglomerates as well as supported by the government. In addition, China should establish R&D centers which are engaged in the basic and general crucial research for drug evaluation, toxicology research, clinical pharmacology, medical experimental animal research, and patent information services. These centers must be collectively planned, and organized. By utilizing the existing bases, the centers should be built at the best locations according to international standard. After completion, the centers' resources and information will be shared with all the industries in China. The Chinese government should provide the activities with financial support.

Third: A special fund for the advancement of S&T of the P&SCP industries should be established. In view of the present and long-range development of these two industries, the establishment of a special fund is absolutely necessary. First, basic research topics need financial support. In this aspect, China is very weak. Should China make no determination to strengthen the basic research or applied basic research, not only can it expect no breakthroughs in the modern S&T front, but also cannot maintain the stamina for future development. Second, the general technical developments, which are important and critical to all in the field of P&SCP, cannot be achieved by a single group or R&D center. Such development requires the cooperation, through funding, of all different trades and regions to tackle the key problems. Third, funding can also support the basic technical facilities and the strategy of certification, testing, standard, and experimental animals for the S&T economic development in the entire industry. Last, the fund can also be used to train qualified personnel, attract S&T personnel from overseas including the overseas Chinese scholars, as well as establish a service system for intelligence, information, intellectual property rights, and other socialized support service systems.

The R&D of the P&SCP industries provide tremendous economic and social benefits. Although a considerably large investment is needed to update R&D to a basically independent level in about 10 years, its production and potential net profit could be several times higher than the investment. In addition to establishing enterprise conglomerates, the increase of S&T investment for P&SCP should also support the building of R&D centers, basic and applied research in the P&SCP field, development of critical but common technology and research in important topics, continued funding for the new pharmaceutical research as established in 1987, expenses for the application and preservation of patents in foreign countries, as well as the commercialization and industrialization of major inventions. Besides, support should be given to the establishment of a P&SCP central patent information library to collect, process, and analyze domestic and international patent information and to provide the industries with consulting services. Additionally, the training of P&SCP high-tech personnel, the organization of international S&T cooperation and exchange, the cultivation of S&T personnel and S&T management personnel with modern technology, management knowledge and ability, and meeting the demands of the policy of reform and opening up, as well

as the promotion of the reform of P&SCP industries should all have government support.

The special fund supporting the advancement of the S&T of the P&SCP industries should directly fulfill the national policy of promoting the advancement of the S&T of the P&SCP industries, the effective application of the reform strategy, and the reinforcement of the macrocosmic adjustment, control, and guidance for transformation in order to provide direct service in organizing China's S&T capabilities to participate in the R&D development.

III. Implement Integrated and Coordinated Measures To Promote the S&T-Dependent Transformation

The development of the P&SCP industries activates the modernization of socialism. Promoting transformation from a mostly imitation industry to independent R&D industry will be an important item on the agenda of reform and development on the S&T front.

1. In the three stages of S&T work, appropriate preference and support will be given to the R&D and the P&SCP industries. In the field of basic research, P&SCP will gain their relative importance. In high, new-tech industry development, the R&D capacity of research institutes, institutes of higher education, and large and medium-scale enterprises will be provided with support to enter the development zones so that respective high-tech enterprises will be set up by taking advantage of the superior operating system of the preferential policy. In the major battlefield of economic construction, the scientific research organizations of technology development will be guided toward the unification of research, production, and management, toward establishing S&T enterprises and enterprise conglomerates, as well as toward the path of S&T industrialization. As far as policy is concerned, these organizations will also be assisted and protected.

2. A new operating system will be established at selected enterprise conglomerates and R&D centers which produce pesticides and pharmaceutical products. The testing sites for S&T systems reform will be promoted to lead the implementation of various important reforms. The best model of cooperation between planning and marketing will be explored and the conglomerates will be guided toward establishing new systems with vitality and vigor as well as toward closing ranks with international standards. At the reform sites, economic construction must be persistently held as the central point. The effect of the marketing system will be brought into full play. The foreign experience will be widely studied and learned from. The developed countries' management methods and experience connecting R&D with intellectual property rights will be considered. The industrial development model fulfilling the demands of commodity economy and S&T advancement will be established. The commercialization, industrialization and internationalization of S&T results to sustain challenges in the broad international environment will be promoted.

3. High quality S&T personnel will be vigorously trained and widely attracted. To realize the transformation, qualified personnel is the key. At present, not only must great efforts be exerted in the training and cultivation of qualified personnel in order to elevate the worker's quality, but also to "fully exploit everyone's capability, and fully utilize this capability." Special efforts should be made to attract the personnel studying overseas to come home and join the construction and R&D work of the enterprise conglomerates and the R&D centers. To solve these problems, work should be really and solidly done and policy measures should be adopted. First, the policy of "offering freedom and convenience of coming and going" to the S&T personnel from overseas should be implemented. Residences should be available to them. The scientific research environment and conditions should be improved. The problems of their salaries and titles should be resolved. Second, a policy should be formulated based on the guideline of "stabilizing one end, but opening all the rest." While basic research is being emphasized, personnel are allowed to work in diversified fields. A certain portion of the S&T personnel in research institutes and the institutes of higher education are encouraged to initiate business in enterprises and enterprise conglomerates. The S&T personnel and the management personnel who make valuable contributions will be awarded and guaranteed rightful higher compensation and honors. Third, the S&T personnel will have strong support to attend international academic exchanges. A group of outstanding S&T personnel, especially young and middle-aged ones, will be selected to advance their studies overseas, to engage in cooperative research, and to expand academic exchange so that their talents and abilities can improve. Fourth, the knowledge of intellectual property rights, international commercial practices, and modern management will be popularized among the S&T and management personnel. They will learn from foreign experiences in R&D, management, and administration. Thus, their abilities in international competition in the field of intellectual property rights will be improved. They will learn how to compete for superior positions through legal manipulation, as well as safeguard and develop their superior standing.

Regardless of whether the consideration is based on present or long-term interests, the establishment of a system of intellectual property rights and R&D conforming to international standards will have an important strategic meaning regarding the exploitation of China's S&T intellectual resources, the building of intellectual-intensive and technology-intensive industries, the development of leading-edge S&T, the realization of industrialization, and the acceleration of socialist modernization. Sooner or later, the new course must be followed, and the sooner the better. China's S&T, national economy, and industrial communities should achieve this same understanding. As long as we persistently believe in the strategic thinking that "S&T is the

first productive force," that the policy of reform and opening up must be further boldly and rapidly carried out, and that the talent and wisdom of S&T personnel must be fully developed, China can definitely transform pressure into motivation and challenges into opportunities and greatly raise the standards of S&T and the economy. Eventually, China and its people will be an independent member among the advanced countries of the world.

State Funds Shanghai Second Medical University and PLA Third Military Medical University 1.9 Million Yuan for Burn Research

93FE0054C Shanghai WEN HUI BAO in Chinese 6 Aug 92 p 1

[Article by Hu Derong [5170 1795 2837]: "China's Natural Science Foundation Granted Second Medical University in Shanghai and PLA Third Military Medical University Substantial Award for Jointly Conducting Applied Basic Burn Research; Highest Level Project Ever in China's Health System, 1.9 Million Yuan Funded"]

[Text] In early August 1992, the Shanghai Second Medical University (SSMU) and the Third Military Medical University (PTMMU) of the People's Liberation Army received a new mission from the State Natural Science Foundation. A sum of 1.9 million yuan was granted to the universities for the approval of the joint project: The Pathogenesis of Early Stage Burns and the Mechanism of Burn Healing. It is a very significant top-level medical and health research project since the founding of the Republic.

Since the beginning of burn research in 1958, China's research standard on the prevention and treatment of burns has always ranked high in the world. The "Ruijing Formula," which has Chinese characteristics, for skin transplant was developed by the Burn Division of Ruijing Hospital, an affiliate of SSMU. The formula has cured more than 10,000 cases. The cure rate of this independently developed procedure is above 90 percent. The procedure is (1) removing the crusts by different batches and in different stages; and (2) using an Allo-skin graft procedure through grafting the burned area with a large perforated sheet of heterogeneous skin mosaicked with small chips of the patient's own skin. China's burn clinic has maintained its leading position in the world. Professor Shi Jixiang, department head of the SSMU Burn Department, and Professor Li Ao, of the PTMMU Institute of Burn Research, have been named "two giants in Burn Pathology" by the world's medical community on burns.

Professors Shi and Li are of the opinion that although China's burn clinic has great strength, its foundation is relatively weak. Should basic research not be stepped up to fully utilize the most current results from high-tech molecular biology and immunology to uncover the mechanism of early stage burns and its healing, China might lose its lead in the prevention and treatment of burns, and the diminished gap between basic and theoretical burn study would widen again.

The project will begin this year and is scheduled for completion in 1996.

Achievements in Industrialization of Biotechnology Research Products

93FE0054A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 21 Sep 92 p 1

[Article by Gu Wanming [7357 8001 2494]: "Encouraging Achievements in Development of Biotechnology Research Products; Industrialization in Fields of Medicine, Health, Agriculture, Forestry, Animal Husbandry, Fishery, Light Industry, and Food Industry"]

[Text] For over 10 years, China's biotechnology research has progressed very rapidly. Especially since the inclusion of biotechnology in the "863 Plan" as one of the key funding areas in 1986, the important achievements in biotechnology have become industrialized in the fields of medicine, health, agriculture, forestry, animal husbandry, food, and light industry, and produced obvious economic and social benefits. The above information has been obtained from the recent Conference on the Development of Genetic Engineering Products convened in Zhuhai held by the State Science and Technology Commission and the State Pharmaceutical Administration.

The first industrialized biological high-tech product—human alpha-genetically engineered interferon (HAGEI)—has been put into production. This was accomplished through the cooperation of concerned experts working on the basis of "Sixth 5-Year" and "Seventh 5-Year" research and through the support of the "863 Plan." Clinical experiments proved that HAGEI is an effective medicine for chronic hepatitis, hairy cell leukemia, and hepatitis C. It is also effective for some malignant tumors.

The genetically-engineered vaccine for hepatitis B surface antigen (HBsAg) has been successfully developed in China. In 1991, the Changchun and Beijing Research Institutes for Biological Products completed the interim tests, and a production capacity for 1 million people has been formed. Clinical tests showed that the antibody formation rate is 100 percent. This vaccine is superior to serum vaccine, and it opens a bright future for the prevention of chronic persistence of hepatitis B in China.

The research of interleukin in China has achieved international standard. The Shanghai Biochemical Research Institute of the Chinese Academy of Sciences has accomplished a high fermentation rate of the gene-recombinated interleukin-II and the new type interleukin-II to 30 percent to 40 percent of the total bacteria protein. About 1 gram of interleukin-II can be obtained from 10 liters of the culture medium. This biological

product is effective in treating cancer and viral diseases by enhancing cell activity in the immune system.

One of the important developments in enzyme technology in China is that genetic-engineering technology has already been used in selective breeding of enzyme-producing bacteria. For instance, the penicilinase from coded cell is entering the production stage. Biotechnological research accomplishments have provided new products for genetically-engineered pharmaceuticals.

Shijiazhuang Becomes China's Largest Pharmaceutical Base

93FE0054B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 4 Aug 92 p 3

[Article by Ding Shaoliang [0002 4801 5328]: "Shijiazhuang Becomes China's Largest Pharmaceutical Base"]

[Text] Shijiazhuang in Hebei Province has become China's largest pharmaceutical base. Statistics show that the city is capable of producing 800 different items in these five major categories: raw medicines, processed medicines, health supplies, medical equipment, and Chinese traditional medicine formulas. The annual worth of these products is 1.5 billion yuan and a yield of 260 million yuan in profit tax.

Among China's pharmaceutical industries, Shijiazhuang ranks first in raw material production for antibiotics, raw material production for ampicillin, and ampicillin powder ampule, theobromine, caffeine, and i.v. infusion production lines.

The secret of the rapid pharmaceutical development in Shijiazhuang is the ceaseless technological innovation and construction aimed at the international standard. In the past 10 years, 360 million yuan was invested in the Shijiazhuang pharmaceutical industry, and 54 items of technological innovations were completed. As a result, over half of the city's pharmaceutical installations has met the international standard. At the same time the city has adopted the policy of "borrow a hen to lay an egg" (the policy of production with foreign assistance), and successfully worked with foreign businesses in establishing three jointly-financed pharmaceutical enterprises. Consequently, the competitiveness of the Shijiazhuang products in the international market has greatly improved.

Frequency Spectrum for AIDS Treatment

93P60073B Beijing GUANGMING RIBAO in Chinese 15 Oct 92 p 2

[Article by Zhou Weibin [0719 2429 2430] and Liu Lusha [0419 6424 3097]]

[Summary] The biological frequency spectrum technology developed by Professor Zhou Lin [0719 2651], director of the Yunnan Biomedical Engineering Research Institute, has been proven to be a promising non-drug therapy for AIDS patients. Based on the resonance absorption principle of physics, Zhou Lin invented a frequency spectrum generator, which produces a human frequency spectrum, to improve blood circulation and regulate nervous systems. After being tested in China, the United States and France, it has brought remarkable results in treating gastrointestinal, liver, kidney diseases, epilepsy, burns, cardiovascular diseases, and AIDS.

Cloning and Sequencing of Anti-Hemorrhagic Fever McAb

93P60073D Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 19 No 4, Aug 92 p 287

[Article by Gao Lei [7559 4320], Chen Sumin [7115 5685 3046], Chen Nanchun [7115 0589 2504], Yang Angang [2799 1344 6921], Han Hua [7281 7520], Liu Xinping [0491 2450 1627], and Cui Yunchang [1508 6663 2490], Institute of Biochemistry, Fourth Military Medical University]

[Summary] A research group in the Institute of Biochemistry of the Fourth Military Medical University has extracted mRNA from the Chinese-developed 87-2 hybridoma, a cell line that secretes the human core protein IgM monoclonal antibody (McAb) to fight hemorrhagic fever renal syndrome virus (HFRSV). The team has also succeeded in cloning and sequencing the heavy chain variable region gene of McAb using the reverse transcriptation polymerase chain reaction (PCR) augmentation technique. Data on restriction endonuclease reaction site, length of open reading frame (ORF) 405 bp (basepair), 135 amino acid genetic codons, backbone region and supervariable region were obtained by computer analysis. An 84.8 percent of sequence homology between the backbone region of McAb and heavy chain variable region of human immunoglobulin was found.

N-terminal QVQLLESGGGLVKPGGSLRLSCAASGFTFSNA-
WMSWVRQAPGKGLEWVGRIKTKTDGGTTDY-
AAPVKGRFTISRDDSKNTLYLQMNSLKTEDT-
AVYYCTTDTLRKIVVVPAAMEETGYSSGWYG-
WGQGTLVTVSS C-terminal

Figure 1. The Amino Acid Sequence of Anti-HFRSV Human 87-2 McAb Heavy Chain Variable Region (areas underlined are three supervariable regions)

Chemical Agent Monitoring Technology Developed by PLA

93P60073A Beijing ZHONGGUO HUANJING BAO [CHINA ENVIRONMENTAL NEWS] in Chinese 24 Sep 92 p 4

[Article by Ye Mingwei [0673 2494 0251] and Zhou Xinming [0719 9515 6900]]

[Summary] Researchers at the Chemical Warfare Laboratory of the Second Artillery's 80303 Unit of the People's Liberation Army (PLA) in Yunnan have developed the technology to monitor and analyze chemical agents which pollute water. The technology has recently passed an assessment held by the Chemical Warfare Institute of General Staff and Chemical Warfare Department of Second Artillery. Material and equipment used are Chinese-made Macromolecule microsphere GDX-502 resins to concentrate the agents, and hydrogen-flame ionizing monitors to analyze trace amounts of nerve agents G and VX in water. The technology is said to be very effective, easy to operate, fast, and accurate, and suitable for quick detection and analysis of chemical agent pollution in Yunnan. It also provides chemical and environmental protection departments a method to detect and analyze quickly pollutants discharged into the environment. The technology has valuable military and economic benefits.

Joint Venture for Animal Toxins Research

93P60073C Kunming YUNNAN RIBAO in Chinese 25 Oct 92 p 1

[Article by Zhou Jianfang [0719 7003 5364]]

[Summary] The Hongyuan Development Company of Dongwan in Guangdong, Wanyexing Development Company of Hong Kong and CAS Kunming Institute of Zoology signed an agreement in Kunming on 21 October to establish a joint venture to develop snake venom and animal toxin resources in Yunnan, speed up conversion of research results to products, and promote industrialization of research results to produce biological pharmaceuticals and biological products from snake venom and other animal toxins for marketing. The two companies will be responsible for capital investment and management, and the institute will provide technology and research results. The total initial investment is 60 million yuan.

Further Reports on Galaxy-II Parallel Supercomputer

Main Details

93P60091A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 46, 25 Nov 92 p 1

[Article by Liu Jiuru [0491 0046 1172] and Li Xiongjie [2621 7160 2638]: "Galaxy-II 1 Billion Operations Per Second Supercomputer Developed"; cf. brief report in JPRS-CST-92-024, 8 Dec 92 p 25]

[Summary] The nation's first independently designed and developed 1 billion operations per second (1 GOPS) supercomputer, the Galaxy-II, passed State appraisal on 19 November at the University of Science & Technology for National Defense (USTND) in Changsha. Developed in 53 months by hundreds of experts in USTND's Computer Institute, the Galaxy-II is China's first general-purpose 1 GOPS parallel processing supercomputer. This system includes four CPUs interlinked by a fast synchronous communications architecture, a multiport crossbar switching network, and high-capacity high-speed [shared] main memory; master clock speed is 50 MHz, main memory capacity is 256 Mbytes, and there are two independent 10 Mbit/s I/O subsystems. The State Meteorological Center is the Galaxy-II's first user, and has already trial-run a mid-range weather forecasting software system on the new supercomputer, with pleasing results. With its network functions, the Galaxy-II is expected to serve a variety of customers, in areas such as petroleum exploration, seismology, nuclear energy, and aerospace.

Details on Design, History, Performance, Housing

93P60091B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Nov 92 p 2

[Article by Wang Hanlin [3769 5060 2651]: "The Great Galaxy's First 9 Days: Tribute to the Galaxy-II 1 GOPS Supercomputer and Its Developers"]

[Summary] At 0930 on 27 October 1992, experts assembled at USTND's Computer Institute in Changsha formally announced that the Galaxy-II 1 GOPS supercomputer had performed stably for 150 hours and that its master clock speed was 50.00123 MHz—a major step forward for domestic supercomputer development. The Galaxy-II can actually perform 400 million 64-bit floating-point calculations per second, constituting an operating speed of 1 GOPS.

Its history began in February 1986, when USTND Computer Institute director Prof. Chen [7115], Senior Engineer Zhou [0719], and a colleague jointly wrote to the Party Central Committee to recommend development of the nation's first 1 GOPS supercomputer—a plea that received the strong support both of the Party Central Committee and the State Council. On 12 March 1988, the State Meteorological Administration, to be the first user of the Galaxy-II, signed a contract with USTND for the new supercomputer's development; but this original Galaxy-II was to be a single-CPU supercomputer able to perform calculations for the early-80s European T63L15 weather forecast. Meanwhile, research on a 2-CPU design and then a 4-CPU design was progressing, and the single-CPU design was discarded in favor of the 4-CPU design, realized by a team of over 260 experts.

The Galaxy-II's printed circuit boards—of which almost 1000 had to be manufactured, each board having 12-14 layers making up a structure dense as a spider web—incorporate very-high-speed surface mount ICs throughout, with double-sided high-density mounting.

Final testing shows that the Galaxy-II's speed-up ratio—the amount by which the entire 4-CPU machine runs faster than the equivalent single-CPU machine—has an average value of 3.537 and a maximum value of 3.8. Utilization factor is over 90 percent.

The Galaxy-II, which has a 3-meter-high hexagonal housing, was formally certified by [42] experts from four institutions nationwide on 19 November; within 2 days time, the new supercomputer had solved the U.S.'s most famous supercomputer test problem. Moreover, the Galaxy-II completed calculations for the late-80s European T63L16 weather forecast almost two times faster than the user's requirement.

Details on Design, Software

93P60091C Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 27 Nov 92 p 4

[Article by Liu Xiangrong [0491 0686 2837]: "Tribute to the Galaxy-II Supercomputer's Developers"]

[Summary] One of the most challenging aspects of the Galaxy-II's development was the design of central processors and logic circuits that would work at 50 MHz, compared to the 20 MHz of the Galaxy-I supercomputer. The new designs—with a pc board inter-line spacing of only 0.15-0.19 millimeter—were greatly facilitated by the model YC-2000 state-of-the-art CAD system, independently developed over a 2-year period by USTND Prof. Li [2621] and her colleagues.

Another significant topic was the development of software. The mid-range weather forecasting applications software system jointly developed over a 5-year period by Prof. Li's team and by software engineers at the State Meteorological Center will make a major contribution to the national economy, since it increases forecasting ability from the current 48 hours up to 5-7 days. The assembler, written in over 100,000 lines of code by Assoc. Prof. Yang [2799] over a 4-year period, is also noteworthy. Finally, the Galaxy-II supercomputer system includes an operating system independently developed over a 5-year period by a USTND team led by Assoc. Prof. Tan [6151] and occupying over 100,000 lines of code.

Hybrid Parallel Computer Architectures for Machine Vision

Two-System Architecture

93P60083A Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese Vol 13 No 11, Nov 92 pp 1-6, 18

[Article by Yang Shiqiang [2799 1102 1730], Xu Guangyou [1776 0342 4368], Li Jingwei [2621 4842 4885], and Jia Xiangyi [6328 4161 1138] of the Department of Computer Science, Qinghua University, Beijing 100084: "Parallel Architecture for Vision Processing"; MS received 30 Apr 92]

[Abstract] Parallel processing is an important topic in computer vision/robot vision. The characteristics of vision processing are analyzed, and architectures suitable for different processing levels are discussed. A parallel robot-vision processing system that is multilevel, task-oriented, and tightly coupled is proposed. The Pipeline Image Processing Engine (PIPE) is chosen for low-level tasks (sensor input, preprocessing, and segmentation) and for a portion of the mid-level tasks (segmentation to description), while a Transputer network is chosen for the remaining mid-level and the high-level (recognition and interpretation) tasks. The PIPE is a single-instruction-stream/multiple-data-stream (SIMD) parallel computer, while the Transputer network is a multiple-instruction-stream/multiple-data-stream (MIMD) parallel computer; the overall parallel architecture is therefore a mixed-mode system that is dynamically (every 1/60 s) reconfigurable in the PIPE portion and is reconfigurable in the Transputer portion via program revisions.

Figure 1 (not reproduced) shows a breakdown of the tasks associated with various processing levels, as summarized above. Figure 2 shows the low/mid/high-level parallel processing system developed by the authors for their research on an integrated intelligent mobile robot vision/navigation system. As shown schematically in Figure 3, the PIPE, a real-time pipelined image processor which carries out one pipeline operation per video field period (1/60 s), consists of a video interface, an input module, 3-8 modular processing stages (MPSs), an output module, an iconic-to-symbolic mapping (ISMAP) module, and six video busses. Each MPS contains three look-up tables (FLUT, RLUT, and BLUT) and two ALUs [arithmetic logic units] forming a multifunctional input device; two local memories (BUF A and BUF B), each capable of storing four 256 x 256 x 8-bit images; one pre-operation look-up table; two parallel convolvers with four operating modes (3 x 3 arithmetic, 9 x 1 arithmetic, 3 x 3 Boolean convolution, and 9 x 1 Boolean convolution); and one functionally strong two-value-function (TVF) look-up table. As shown in Figure 4, the PIPE has three local data channels (forward, recursive, and backward) and six global data channels (video busses). Figure 5 below shows two of the possible Transputer network topological structures. For the host, one can use either a PC-bus-based microcomputer such as a 386 or a VME-bus-based Sun workstation. The authors have studied both the 5-PE [processing element] TMB04 Transputer parallel processing acceleration board (PC bus) and the 16-PE VME-bus-based acceleration board. On the TMB04, one of the PEs is the MASTER node, with 4 Mbytes of memory, for communications with the host and for management; the other four PEs each have 1 Mbyte of local memory.

Using this PIPE + Transputer parallel system, the authors have perfected a number of algorithms,

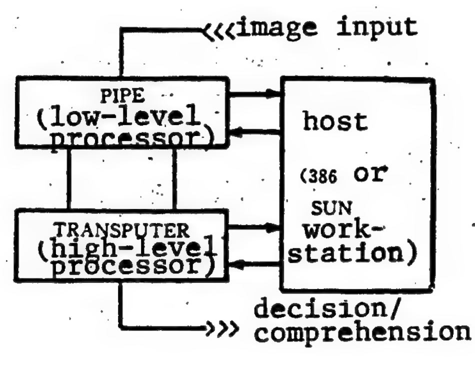

Figure 2. PIPE + Transputer System

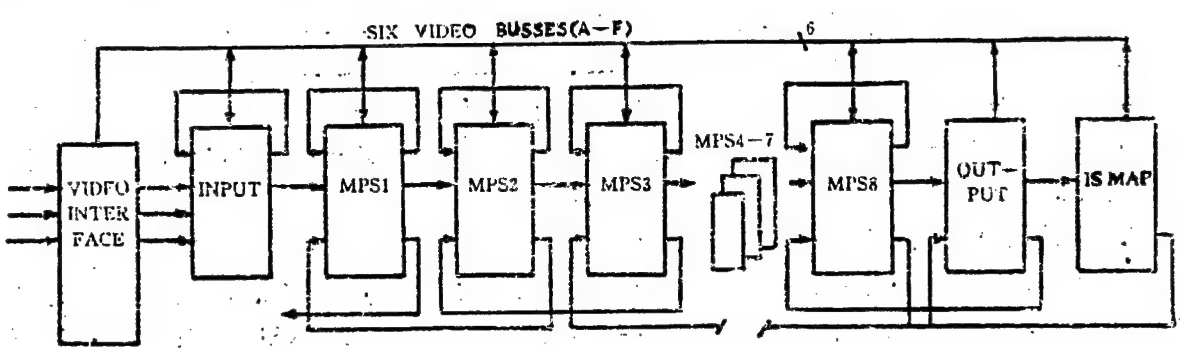

Figure 3. PIPE Overall Structure

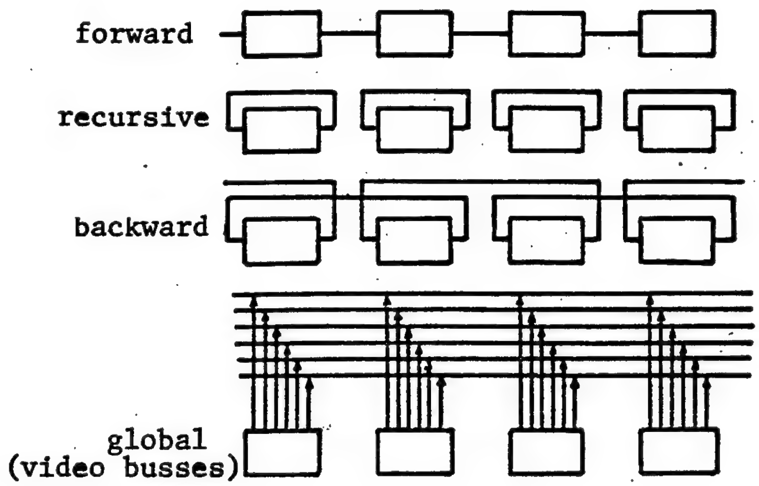

Figure 4. PIPE Data Channels

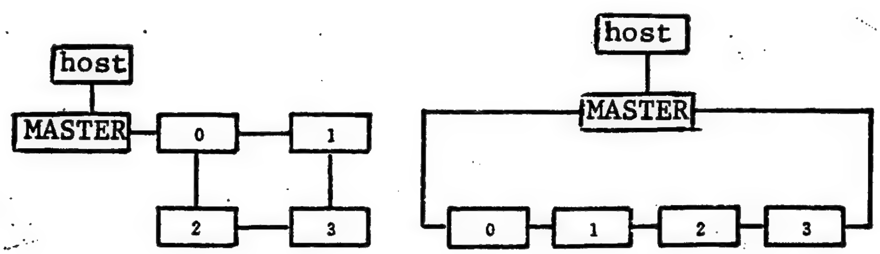

Figure 5. Transputer Topological Structures

including stereo vision matching,[4] image compression coding,[5] real-time obstacle detection,[6] and color channel segmentation, with promising results.

References

1. M. Maresca et al., "Parallel Architecture for Vision," PROC. OF IEEE, Vol 76, No 8, August 1988.

2. J. D. Crisman and J. A. Wobb, "The Warp Machine on Wavlab," IEEE TRANS. ON PAM1, Vol 13, No 5, 1911 [as published; ?1991].

3. PIPE Reference Manual.

4. Xu Guangyou et al., "Stereo Vision Matching Algorithm for Pipeline Architecture," JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS], to be published.

5. Yang Shiqiang et al., "Parallel Image Coding Using a Transputer Network," Fourth Annual Conference of the China Image Association, 1992.

6. Zhu Zhigang and Lin Xueyan, "Real-Time Algorithms for Obstacle Avoidance," MVA90 Japan.

Three-System Architecture

93P60085A Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Vol 15 No 11, Nov 92 pp 809-814

[Article by Zhong Yuzhuo [6988 3768 3820], Qiao Bingxin [0829 4426 2450], Xu Guangyou [1776 0342 4368], and Shen Meiming [3088 5019 2494] of the Department of Computer Science & Technology, Qinghua University, Beijing 100084: "A New Vision Computer"; MS received 9 Dec 91]

[Abstract] Vision information processing involves extracting, describing and explaining information from images of 3D environments. It can be divided into three levels according to technical complexity and methods used: low-level vision (iconic I/O), mid-level vision (iconic input but symbolic output), and high-level vision (symbolic I/O). Based on characteristics and requirements of each level, this paper proposes a DSP-based

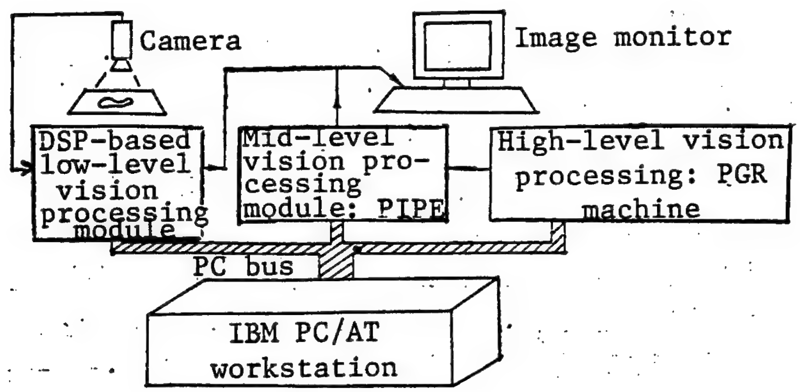

Figure 1. Hybrid Vision Computer Architecture

[digital signal processor based] low-level vision processing module, a mid-level vision processing module consisting of ASPEX Inc.'s PIPE (Pipelined Image Processing Engine], and a high-level vision processing module consisting of the Transputer-based PGR (Parallel Graph Reduction) Machine. Working on the same platform—an IBM PC AT—these three modules compose a hybrid vision computer, which may be an efficient solution for processing images with large volumes of data and critical real-time requirements, such as in mobile robot vision.

The overall architecture of the proposed hybrid vision computer is shown below in Figure 1, while Figure 2 below shows a mapping of various vision-processing algorithms onto the three hardware modules. The independently designed DSP-based low-level module, detailed in ref. 5, is comprised of two basic components: (1) A camera video signal acquisition/storage/display system, which A/D converts the video input into three 512 x 512 x 8 frames stored in frame memory devices—one frame memory stores the original input image while the other two store processed results, such as convolution of most significant bit and least significant bit. The digitized signals are then D/A converted and sent through a color-matching board, and then to a color display. The output portion of this entire system incorporates the INMOS Co.'s IMSG 175 color look-up table (LUT), permitting 256 K pseudo color shades. (2) The other basic component is the image preprocessor, comprised of a DSP unit and an I/O LUT; the latter incorporates 256 x 8 x 4 SRAMs and has programmable transform functions. The heart of the image preprocessor is INMOS's A110 image/signal processing subsystem [ref. 6], which has 21 multiplier/adders providing a performance of 420 MOPS.

The mid-level module consists of ASPEX Inc.'s PIPE [ref. 8], which provides image segmentation, description, and recognition [see schematic of PIPE architecture in

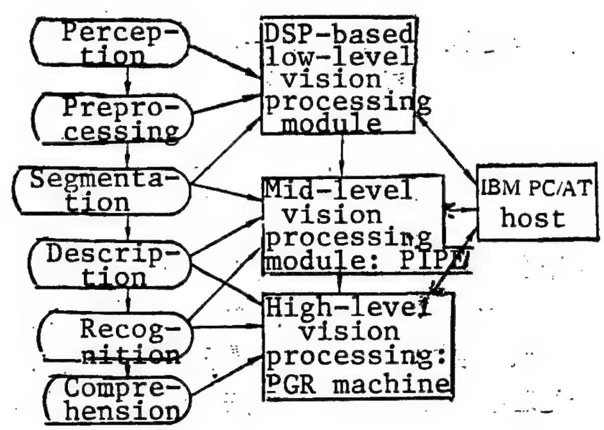

Figure 2. Vision Processing Algorithms Mapped Onto Hardware Modules

previous article in this JPRS report]. With the PIPE, the authors have implemented KG-transform-based real-time (within 0.5 s) obstacle detection in a mobile robot vision system and have developed a stereo-vision parallel algorithm based on a loose matching method [ref. 9]. Experiments show that for a 256 x 256 image with a parallax of eight pixels, the entire algorithm can be completed in 10 seconds.

The high-level module consists of the PGR simulation system developed by the authors [ref. 12]. This system, whose hardware configuration and structure are shown in Figures 3 and 4 below, consists of two B003 boards, each with four processing element (PE) modules, each module containing one 20 MHz T414 Transputer and 256K DRAM, and one B004 board, containing one T414, 2MB of RAM, and IBM PC bus interface logic. The system host is an IBM PC AT or 386 running the TDS 700D Transputer Development System.

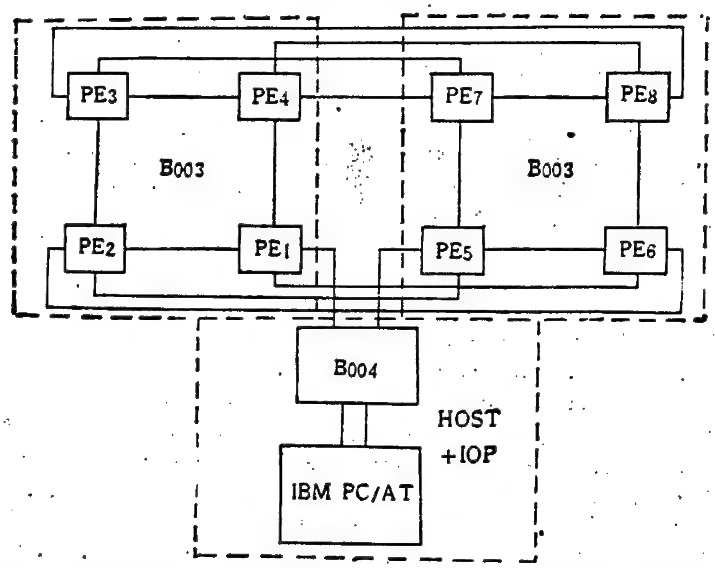

Figure 3. Hardware Schematic for PGR Machine Simulation System

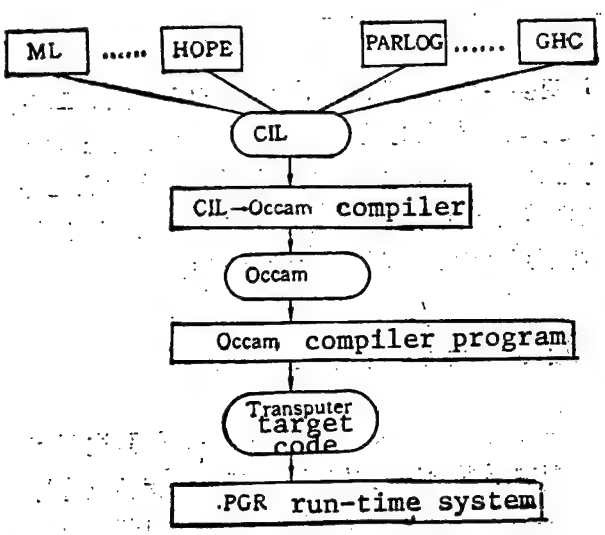

Figure 4. PGR Simulation System Structure (ML = machine language, CIL = Compiler Intermediate Language)

References

1. Josef Kittler, Michael J. B. Onff, "Image Processing System Architectures," Research Studies LTD, England, 1985.

2. Zhong Yuzhuo, Yang Jun, "Survey of Video Signal Processing System Architectures," Modern Computer Technology Reader, Vol 1, Electronics Industry Publ. House, 1991.

3. Fu Jingxun, R. C. (Gang-sa-lei-si), C. S. G. Li, "Robotics," China Science & Technology Publ. House, Beijing, 1989.

4. Pietikainen, M., Seppanen, T., Alapuranen, P., "A Hybrid Computer Architecture for Machine Vision," IEEE CH2898, 1990, 426-431.

5. Zhong Yuzhuo, Huang Changhua, "Design of Fast Processors for Robot Vision Signals Based on DSP Methods," Proc. of 2nd National Conference on Robotics, Shenyang, 1989.

6. IMS A110 Image and Signal Processing Subsystem, INMOS Digital Signal Processing Data Book, July 1989, SGS-Thomson, 47-76.

7. Kung, H. T., "Why Systolic Architecture?," COMPUTER, 5:(1), 1982.

8. Introduction to PIPE Model 1 System, ASPEX Incorporated, 1987.

9. Xu Guangyou, Lin Xueyin, "Vision Processing and Environmental Model Building," Action Planning Technology and Research Technical Report, Qinghua University Computer Department, January 1991.

10. Gddenberg, R., Lan, W. C., She, A., and Waxman, A. M., "Progress on the Prototype PIPE," 1987 Workshop on Computer Architecture for Pattern Analysis and Machine Intelligence, 1987.

11. D. H. Balade, C. M. Bulang, "Computer Vision," Science Publ. House, Beijing, 1987.

12. Cen Shanwei, Shen Meiming, Wen Dongchan, "PGR: A Parallel System Based on Expanded Graph Reduction Models," Qinghua University Computer Department, 1991.

Contract Signed for Construction of Qinshan NPP 300 MW Full-Range Simulator

93P60096 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 30 Nov 92 p 1

[Article by Wang Hui [3769 6540]: "Asia Simulation Ltd. To Manufacture Full-Range Simulator for Qinshan 300 Megawatt Nuclear Power Generating Units"]

[Summary] A contract for manufacture of a full-range simulator for the 300 MW Qinshan Nuclear Power Plant has been formally signed in Zhuhai. This full-range simulator, critical equipment for training personnel in safe operating principles, will incorporate nineties-level internationally advanced technology. According to the contract, the simulator will be manufactured by Asia Simulation Control Systems Engineering Ltd. and turned over to the Qinshan Nuclear Power Corporation within the next 36 months.

Additional Details on Sino-U.S.-Hong Kong JV UNIX System Technology Ltd.

93P60092A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 18 Nov 92 p 2

[Article by Liu Keli [0491 0344 7784]: "China Gets Operating System Joint Venture"; cf. brief report in JPRS-CST-92-025, 16 Dec 92 p 29]

[Summary] The Sino-U.S.-Hong Kong joint venture (JV) UNIX System Technology Ltd.—China's first computer operating system JV—was formally established in Beijing on 6 November by the U.S. firm USL (UNIX System Laboratories, part of AT&T), the Hong Kong firm Deshi [1779 1395] (DASCOM), Beijing Municipality, and six major Chinese hardware and software manufacturers (Great Wall, Chang Jiang, Zhongruan, Langchao, Kangdi, and the Beijing Modern Information Group). The aim of this new JV is to provide the most advanced UNIX technology and products to Chinese computer firms and end users on a timely basis and at a reasonable price. In particular, UNIX has announced the commercialization of its UNIX IV version 4.2 system, the Chinese-character version of which is being manufactured by major Chinese computer software makers and marketed by the Great Wall Computer Group. USL holds 30 percent of the stock in the new JV, DASCOM holds another 30 percent, Kangdi holds 15 percent, the other five Chinese manufacturers hold a total of 5 percent [and Beijing Municipality holds the remaining 20 percent].

Digital Image Processing, Computer Simulation for Spaceborne SAR

93FE0185A Beijing YUHANG XUEBAO [JOURNAL OF CHINESE SOCIETY OF ASTRONAUTICS] in Chinese No 4, Oct 92 pp 89-95

[Article by Li Chunsheng [2621 2504 0581], Li Jingwen [2621 2529 2429], and Zhou Yinqing [0719 5593 3237] of Beijing University of Aeronautics and Astronautics: "Digital Image Processing, Computer Simulation for Spaceborne SAR," a high-technology subject in the "863 Plan"; MS received 8 Aug 91]

[Excerpts] **Abstract**

An imaging processing method for spaceborne synthetic aperture radar (SAR) based on the characteristics of SAR is proposed. Major items including radar echo, azimuth processing, multi-look processing and estimation of Doppler parameters are analyzed and discussed. Computer simulation of terrain image and spaceborne SAR imaging with azimuth processing, range migration correction, multi-look processing and motion compensation is made. The result of computer simulation indicates that the method is effective.

I. Introduction

There are several basic methods for performing digital SAR image processing. One is to realize it with software on a computer. A second is to use a mainframe computer. A third is to use a hard-wired computer equipped with storage and FFT [fast Fourier transform] hardware that is designed to meet the requirements of the SAR algorithm and data flow. The processing speed is very high; however, this method is not very flexible. A fourth method is to program a minicomputer or a microcomputer with an array processor to perform the processing. This kind of small processor has the same data processing throughput as a 100 MIPS supercomputer and is the current trend of development of computer-based SAR processing systems.

A spaceborne SAR processing system consists of five parts. Range processing and azimuth processing handle range compression and azimuth compression, respectively. Multi-look processing is a non-coherent cumulative process employed to reduce image spots. Clutter locking and self-focus processing are performed on azimuth compressed data to estimate deviations of Doppler frequency and rate of Doppler frequency change due to antenna direction error and unstable motion of SAR carrier. The reference parameter generator is used to generate a range reference function and an azimuth reference function based on SAR parameters, ephemeris data, and estimated Doppler frequency deviation and rate of Doppler frequency change variation. The core of SAR processing includes azimuth processing, clutter locking and self-focus processing. A time- and frequency-domain hybrid correlation method is proposed to perform azimuth compression for digital imaging processing of a spaceborne SAR with motion compensation. Furthermore, computer simulation of spaceborne SAR multi-look image processing is performed. [passage omitted]

VII. Computer Simulation

The satellite and radar parameters used in computer simulation are as follows:

Mean satellite altitude	H = 600 km
Long axis	a = 6968.600 km
Eccentricity	e = 0.0011
Mean earth radius	R_e = 6377 km
Radar operating wavelength	λ = 0.235 m
Range signal bandwidth	B_r = 20 MHz
Pulse repetition frequency	PRF = 1450 Hz
Transmitter pulse width	Δ = 32 μs
Time-bandwidth product	$B_r \Delta$ = 640
Frequency modulating slope	a_r = 625 KHz/μs
Sampling frequency	fs = 24 MHz
Antenna viewing angle	θ = 20°
Antenna azimuth dimension	D_a = 12.5 m
Antenna range dimension	D_r = 2.10 m
Range sample points	N_r = 320
Azimuth sample points	N_a = 5201
Number of looks	N = 4
Resolution	$\delta_a \times \delta_r$ = 25 m x 25 m
Imaging area	ΔS = 5.12 km x 10.24 km

In radar system simulation, an important task is establishing a model to describe the environment. The function of the SAR system is to provide real-time plots of large areas on either side of the radar carrier in order to create a high-resolution radar image of the terrain. Since it is used to plot the terrain, ground echo is not considered as clutter. Instead, it is an extended target. An extended target is an object that is larger in size than the resolution of the radar. When objects are smaller than a unit resolution, they can be treated as scattering points. The targets SAR plots are mostly natural objects such as mountains and rivers and man-made objects such as highways, bridges, military installations and targets. Since the resolution of SAR is relatively high and each resolution cell is small, these targets are all treated as extended targets. Based on the capability of SAR, a model is established according to the following principles:

1. The model should represent certain features of the terrain.

2. The model must be consistent with the terrain in proportion.

3. The model should include features and targets that match the basic capability of SAR.

4. The model should incorporate varying target reflection coefficients due to undulatory terrain and ground roughness.

Based on the characteristics of spaceborne SAR, computer simulation of the imaging processing method described earlier is performed assuming that range compression has been completed. Figure 2 [photograph not reproduced] shows a picture of the original terrain. Figure 3 [photograph not reproduced] shows the result obtained without compensating for deviations of f_D and f_R. Figure 4 [photograph not reproduced] shows the result after clutter locking and self-focus processing.

The simulated ground scene is an airport comprised of 97,340 points. Neighboring range points are 16 meters apart and neighboring azimuth points are 16 meters apart as well.

	Range	Azimuth
Original ground picture size	16 m x 320 points	16 m x 640 points
Imaging scale	320 range gates	640 resolution units
Precise Doppler parameters are:		
	R_0 = 644738.6646 m	
	f_D = -286.7191 Hz	
	f_R = 700.1635 Hz/s	

The image produced with unprecise Doppler parameters (Figure 3) is shifted to the right and not properly focused. Let the unprecise Doppler parameters be:

$$f_D = -136.7191 \text{ Hz}$$
$$f_R = 690.1635 \text{ Hz/s}$$

The estimated values of f_D and f_R of the image obtained after two treatments of clutter locking and self-focus processing (Figure 4) are -286.5170 and 700.2651, respectively. They are very close to the precise Doppler parameters. The result of a great deal of computer simulation of different ground pictures shows that the accuracy of estimation of Doppler frequency and rate of Doppler frequency variation are $\Delta f_D < 3\text{-}20$ Hz and $\Delta f_R < 0.3$ Hz/s, respectively. Due to limitations of paper length, only one set of results is presented.

VIII. Conclusion

Theoretical analysis and computer simulation show that azimuth processing is the core of image processing which requires most of the computation load. Considering the hardware requirement and physical constraints, it is more desirable to perform azimuth compression using a hybrid time- and frequency-domain correlation method. One problem needing further consideration is that when performing clutter locking and self-focusing processing, f_D can be estimated more precisely if target scattering is relatively uniform. The estimation of f_R, however, is less desirable. Conversely, when target scattering is non-uniform, the estimation of f_R is more favorable and that of f_D is less than ideal. This azimuth processing method is more suitable for real-time processing of spaceborne SAR signals.

References

1. Li Chunsheng, Li Jingwen, and Zhou Yinqing, "Digital Signal Processing Algorithms for Azimuth in Spaceborne SAR," XINHAO CHULI XUEBAO [JOURNAL OF SIGNAL PROCESSING], No 2, 1990.

2. Li Chunsheng, Li Jingwen, and Zhou Yinqing, "Image Processing of Spaceborne SAR," DIANZI XUEBAO [ACTA ELECTRONICA SINICA], No 1, 1991.

3. Chialin, K. Y. Liu, Michiel Jin, "Modeling and a Correlation Algorithm for Spaceborne SAR Signals," IEEE TRANS. ON AEROSPACE AND ELECTRONICS SYSTEMS, Vol AES-18, No 5, September 1982. 1982, AES-18 (5).

4. F. K. Li, D. N. Held, J. Curlander, and Wu, "Doppler Parameter Estimation for Spaceborne Synthetic-Aperture Radars," IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, January 1985, LE-23 (1).

5. Michael Y. Jin, "Optimal Doppler Centroid Estimation for SAR Data From a Quasi-Homogeneous Source," IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, November 1986, CE-24 (6).

FEL Pumped by Soliton Laser

93P60082A Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 41 No 9, Sep 92 pp 1431-1435

[Article by Zhang Yibo [1728 3015 3134] of the Department of Electronic Engineering, Southeast University, Nanjing 210018, and Jiang Huabei [5592 5478 0554] of the Center for Research in Electro-Optics and Lasers (CREOL), University of Central Florida, Orlando FL 32816, and Department of Physics, University of Science & Technology of China, Chengdu 610065: "A New Short-Wavelength Free Electron Laser"; MS received 4 Oct 91, revised 21 Jan 92]

[Abstract] A scheme for building a novel free electron laser (FEL) operating in the soft X-ray region—a soliton-laser-pumped FEL—is proposed. Using soliton-laser wave evolution shape and single-pass small-signal analysis, it is found that this novel FEL has two special advantages over previous EMW undulator FELs, namely, (1) a very small "mass-shift effect," arising from the special characteristics of soliton lasers, and (2) an additional "frequency-tuning effect" based on the tuning ability of a conventional FEL. The small-signal gain is obtained and discussion is carried out.

The small-signal grain[5] equation is

$$G = (e^2/\varepsilon_0 m_0{}^2 c^5)\,(\lambda^{3/2}/\lambda_0{}^{1/2})(L_u{}^3/\sigma_e)\,(I/I_A)s(df(x)/dx),$$

where σ_e is the e-beam cross sectional area, I is the current passing through the laser mode region, I_A is 17,000 A, s is the pump energy-flow density, $f(x) = (\sin x/x)^2$ is the gain function, $x = \Delta\omega T/2$, and $T = L_u/\beta_0 c$. Typical parameters are as follows: $\lambda_0 = 1.5$ µm and $L_u = 2$ m. The optimum value of x is determined to be 1.3. Figure 1 (not reproduced) plots the gain function ($-df_A/dx$) against x for values of x up to 100 and for a pump energy of 100 times the critical pump energy; values of $\rho = L_u/4z_p$ (where Z_p is the equivalent Rayleigh distance) are indicated along the curve.

References

1. J. M. J. Madey, AIP Conf. Proc., 118 (1984), 12.

2. C. A. Brau, IEEE J. QUANTUM ELECTRONICS, QE-21 (1985), 824.

3. R. Fernow et al., "Proposal for a Picosecond Pulsed X-Ray Source in the 2-20 keV Region," BNL Internat. Report (1986).

4. A. Hasegawa, "Optical Soliton in Fibers," Springer-Verlag, Berlin, 1989.

5. J. Gea-Banacloche et al., IEEE J. QUANTUM ELECTRONICS, QE-23 (1987), 1558.

6. L. F. Mollenauer et al., OPT. LETT., 8 (1983), 289.

Airborne Radar Antenna Digitized Angle-Tracking Servosystem R&D Project

93P60086A Chengdu DIANZI KEJI DAXUE XUEBAO [JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY (UEST) OF CHINA] in Chinese Vol 21 No 5, Oct 92 p 477

[Article by Bian Xuan [0593 1357]: "Introduction to Research Achievement: Digitized Angle-Tracking Servo Microprocessor-Controlled System"]

[Summary] This system incorporates 16-bit microprocessor (TI's TMS32020 monolithic processor) technology into the front end of an airborne radar antenna angle-tracking servosystem, which is more accurate and flexible than its analog counterpart. For both scan and track modes, the antenna servosystems have been independently designed into one broadband slave (follower) circuit. Spatial-domain scan accuracy is +/- 2°, angle-tracking error is less than 0.3 percent rms, scan graphical error is less than or equal to 2.2 percent rms, steady-state tracking error is 0.133 percent rms, and glint suppression is 0.184 percent rms. Overall system design and implementation meet 1980's advanced international standards.

World-Class Domestically Made Industrial CO_2 Laser Unveiled

93P60088A Beijing RENMIN RIBAO [PEOPLE'S DAILY OVERSEAS EDITION] in Chinese 16 Dec 92 p 1

[Article by Chen Xuanqing [7115 1357 1987]: "Major Breakthrough for Nation's Industrial Laser Applications"]

[Summary] Chinese engineers have made a key breakthrough in industrial laser applications—one of the Eighth 5-Year Plan priority areas—with their development of the first domestic microcomputer-controlled, optomechatronically integrated transversal-flow high-power CO_2 laser for industrial cutting and machining. This new laser, unveiled at the Sanle [0005 2867] Electrical Corporation in Nanjing and officially certified by MMEI, uses domestically made components throughout, and will earn much foreign exchange for the State, since China heretofore has relied on imports of such high-power industrial lasers, costing at least US$200,000 each. At the formal MMEI appraisal, experts judged eight technical performance indicators—including optoelectronic parameter control performance and electromechanical integration—as matching or exceeding those of the comparable U.S.-made product; rated power exceeds that of the U.S.-made product by 20 W, and maximum output power (1750 W) exceeds that of the U.S.-made product by 100 W. Overall, technical performance meets mid-to-late-eighties international standards but at a price only one-third that of comparable foreign-made products—indicating a strong competitive potential for this laser on the international market.

Analysis and Design of Diode LIDAR Imaging Systems

40100041A Chengdu DIANZI KEJI DAXUE XUEBAO [JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA] in Chinese Vol 21 No 5, Oct 92 pp 512-517

[English abstract of article by Wang Weiran and Wang Yifei, Chengdu 610054, Inst. of Applied Physics, UEST of China; MS received 25 Jun 92, revised 3 Sep 92]

[Text] Several important problems for intensity imaging, including improving laser power utilization ratio and receiving sensitivity in laser imaging systems, are described. The improvement in SNR of imaging systems is the criterion of the analysis and comparison. Waveform designs of both the maximum power limited and the average power invariant are analyzed separately. In order to understand avalanche gain contribution to receiver SNR, performance comparisons of receiving are evaluated for detection type and operation state. The comparisons include intensity modulated (IM)/coherent detection (CD) and IM/direct detection (DD) for different avalanche gain values and different photodetector load resistance values. According to the relations between receivable return power and SNR, a series of curves are calculated by a computer. These curves clearly show the best detecting type for various receiver power level. The results of the analyses provide theoretical

bases for transmitter and high-sensitivity receiver design. These analyses also show that in intensity imaging systems correct waveform selection can make 4 dB improvement on SNR and reasonable receiver trade-off design can make about 30 dB improvement on SNR.

High Harmonic Cyclotron Maser With Inner Slotted Coaxial Structure

40100041B Chengdu DIANZI KEJI DAXUE XUEBAO [JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA] in Chinese Vol 21 No 5, Oct 92 pp 518-523

[English abstract of article by Hu Jiankai and Li Hongfu, Chengdu 610054, Inst. of High-Energy Electronics, UEST of China; MS received 31 Mar 92, revised 22 Jun 92]

[Text] The RF field of the inner slotted coaxial structure as an example of a multi-conductor structure is analyzed. For a 16-slot structure (π-mode operation), the transverse wave number is calculated. Meanwhile, considering the thickness of the electron beam, the interaction efficiency between electrons and the RF field is calculated numerically at f_0 = 35 GHz by applying the orbit theory and the influence of the parameters on the electron efficiency is analyzed. The results show that inner slotted structure is good for an increase in the interaction efficiency.

Experimental Investigation of 10 kW Transversal Flow Discharge CO_2 Laser With Tube-Plate Electrodes

40100040A Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 10, Oct 92 pp 728-734

[English abstract of article by Cha Hongkui, Lu Hongfei, et al. of Shanghai Institute of Optics and Fine Mechanics, CAS, Shanghai; MS received 9 Dec 91, revised 20 Mar 92]

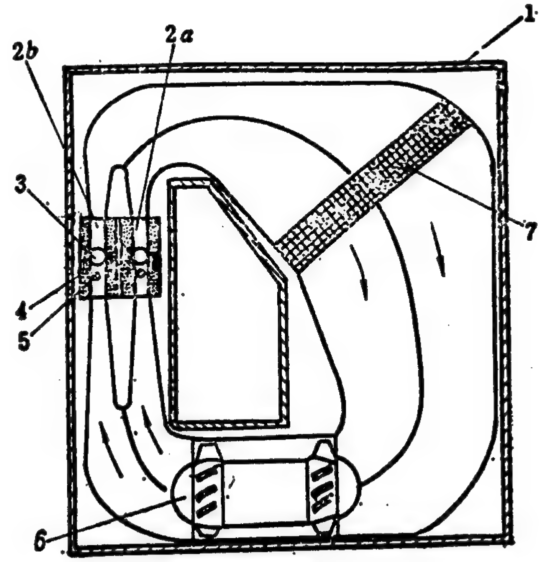

Figure 1. Schematic of the 10 kW CO_2 Laser

1. Chamber; 2a, 2b. Inside and outside discharge channel; 3. Optic cavity; 4. Anode; 5. Cathode; 6. Blowers; 7. Heat exchanger

[Text] A transversal flow CW CO_2 laser with pulsed auxiliary discharge was developed. The discharge characteristics were investigated experimentally. The results of gain coefficient and output power are presented both numerically and experimentally. A maximum output power of 12,600 W has been obtained. Sealed-off CW operation for more than 8 hrs can be obtained for each gas refilling with output power 10,200 W and power unstability of +/- 1.5 percent.

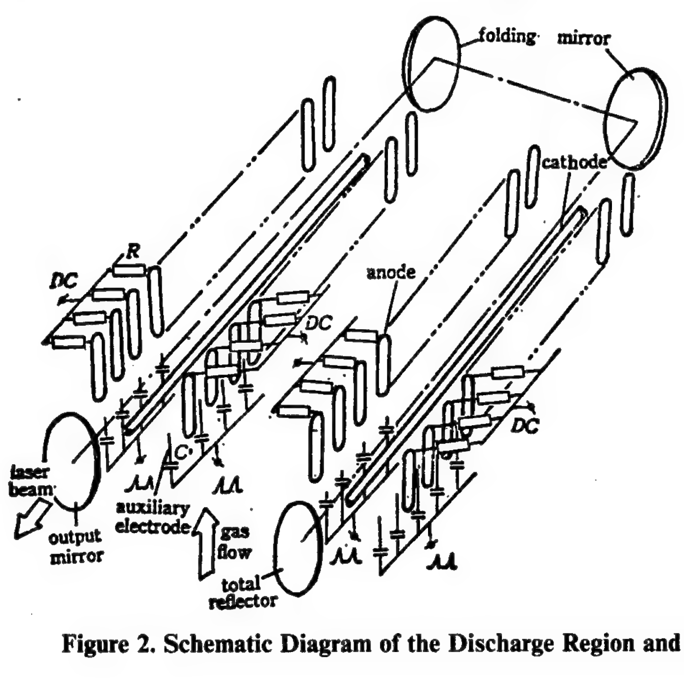

Figure 2. Schematic Diagram of the Discharge Region and Optic Cavity

In-Situ Preparation of High-T_c Superconductive Films Using Plasma-Assisted Laser Ablation

40100040B Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 10, Oct 92 pp 774-776

[English abstract of article by Fan Yongchang, An Chengwu, Man Jiahai, Lu Dongsheng, and Li Zaiguang of the National Laboratory of Laser Technology, Huazhong University of Science and Technology, Wuhan 430074; MS received 21 Oct 90]

[Text] High-T_c superconducting Y-Ba-Cu-O films with zero-resistance temperature of 91 K and critical current density of about 10^5 A/cm^2 at 77 K have been reproducibly fabricated in situ by plasma-assisted laser ablation method. The SEM micrographs and X-ray diffraction patterns show that these films are of excellent epitaxial quality and are oriented mostly with c-axis perpendicular to the substrate surface.

CW Neodymium-Doped Silica Single-Mode Fiber Laser Operating at 1.088 μm

40100040C Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 19 No 10, Oct 92 pp 788-789

[English abstract of article by Chen Yihong, Cheng Ruihua, Shen Hongwei, and Gan Fuxi of Shanghai Institute of Optics and Fine Mechanics, CAS, Shanghai; MS received 5 Sep 90]

[Text] CW laser emission at about 1.088 μm is reported in a 2.7-m-long neodymium-doped silica single-mode fiber pumped by 514.5 nm Ar ion laser. The fiber ends were cleaved and directly butted to dielectric mirrors. An absorption threshold power of 7 mW and a slope efficiency of 8 percent were obtained. A maximum output power of 1.6 mW was achieved.

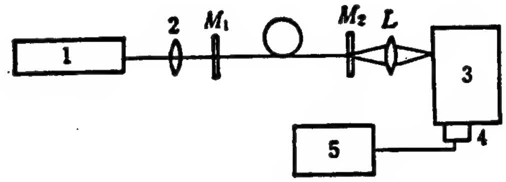

Figure 1. Schematic Diagram of Experimental Setup

1. Ar^+ laser; 2. Condenser lens; 3. WDG 30 monochromator; 4. Detector; 5. Recorder

Enhancement of Photoelectron Emission Efficiency of Negative Electron Affinity GaAs Cathode by Embedded GaAs/AlAs Multilayer Reflector

40100039A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 11, Nov 92 pp 675-682

[English abstract of article by Xu Hongwei and Wang Dingsheng of Surface Physics Laboratory, Institute of Physics, CAS, Beijing, 100080; MS received 11 Jul 91, revised 29 Oct 91]

[Text] Because usual negative electron affinity (NEA) GaAs photocathodes are highly doped and thus have short minority carrier diffusion length, a GaAs/AlAs multilayer reflector under the active layer will enhance the quantum yield by increasing the photoexcitation in the effective region of the photocathode and introducing an electron barrier at the interface. The design and measurement of the characteristics of the multilayer reflector were made and photoelectron emission yields were calculated for the structures with GaAs/AlAs multilayer reflectors. The optimum design parameters for the active layer thickness and initial photoemission measurements are discussed.

Structure Analysis of Nano-Size Crystalline Silicon Films

40100039B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 11, Nov 92 pp 683-689

[English abstract of article by He Yuliang, Cheng Guangxu, Wang Luchun, and Li Qi of the Department of Physics, the Lab. of Solid State Microstructure, Nanjing University, Nanjing, 210008, and Yin Chenzhong of the Department of Electrical Engineering, Jiangnan University, Wuxi, 214063; MS received 6 Aug 91, revised 17 Nov 91]

[Text] We have fabricated nano-size crystalline silicon films (nc-Si:H) by using high hydrogen diluted silane as the reactive gas and activated at r.f+D.C. double power sources in a conventional PE-CVD deposition system. The structures of the grown films were evaluated by means of HREM, Raman scattering spectra, X-ray diffraction pattern, IR transmission spectra and ultraviolet-ray analysis. The results show that there are novel structural performances and strange physical properties; the nc-Si:H films have their unique features and are different from a-Si:H and μc-Si:H films.

Time Evolution of the Infrared Absorption and Photoluminescence of Porous Silicon in Air

40100039C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 13 No 11, Nov 92 pp 715-719

[English abstract of article by Zhang Lizhu, Mao Jinchang, et al. of the Department of Physics, Beijing University, Beijing 100871, China, and Zhu Wuxin of the General Research Institute of Non-ferrous Metals, Beijing 100088, China; MS received 14 Apr 92, revised 14 May 92. This work is supported by the Doctoral Program Foundation of Institution of Higher Education.]

[Text] We have fabricated porous silicon by anodizing single-crystal silicon in HF (48 wt.%): H_2O = 1:1 and detected the Fourier-transform infrared (FTIR) absorption and photoluminescence of the porous silicon wafers after exposing them in air for 2h, 26h, 7 days, and 30 days. We have observed that the localized vibrational mode absorption related to oxygen increases with time and those related to hydrogen and to fluorine decrease as the exposure time increases. The speed of the former is much higher than those of the latter, while the speed of the photoluminescence degradation is just between those of the former two.

DC-SQUID of Tl-Based Thin Film With Flux Transformer

40100043A Hefei DIWEN YU CHAODAO [CRYOGENICS AND SUPERCONDUCTIVITY] in Chinese Vol 20 No 4, Nov 92 pp 20-23

[English abstract of article by Hao Fengzhu of Hebei Institute of Semiconductors, Shijiazhuang, Xue Shouqing of the National Institute of Metrology, Beijing, and Yan Shaolin of the Dept. of Electronics, Nankai University, Tianjin; MS received 31 May 92, revised 31 Aug 92]

[Text] A DC-SQUID of Tl-based thin films has been developed, and a DC-SQUID with flux transformer has also been made. The flux transformer and DC-SQUID were fabricated on same thin-film substrate, avoiding the difficulty of single-chip coupling alignment between flux transformer and DC-SQUID. The preliminary measurements show with flux transformer the magnetic field sensitivity [4.9 x 10^{-4} $\varphi_0/Hz^{1/2}$ at 77K in 0-1 Hz range] can be improved by six times compared to the bare DC-SQUID as a magnetometer.

Low-Noise Amplifier for dc-SQUID Signal Detection

40100043B Hefei DIWEN YU CHAODAO [CRYOGENICS AND SUPERCONDUCTIVITY] in Chinese Vol 20 No 4, Nov 92 pp 45-50

[English abstract of article by Zhang Lihua, Weng Yaojun, and Chen Lie of the Institute of Physics, CAS, and Li Hong of the Cryogenics Laboratory, CAS, Beijing; MS received 11 Jul 92]

[Text] The design and performance of a low-noise FET amplifier, which is used as a preamplifier to detect the dc-SQUID signal in a superconducting magnetometer, is described. The influence of transmission line connecting the dc-SQUID probe to the preamplifier on the input current noise is analyzed. Using twisted enamel-insulated wire pair as transmission line, the voltage noise of the preamplifier is 0.48 nV/$(Hz)^{1/2}$, the current noise is 79.2 fA/$(Hz)^{1/2}$ at the dc-SQUID modulation frequency of 50 KHz, the gain is 66 dB, and the 3-dB bandwidth is from 15 KHz to 150 KHz. [This amplifier has been incorporated in the model PIC-1 dc-SQUID superconducting magnetometer, with a 1-Hz flux noise of 1 x 10^{-4} $\varphi_{0\ rms}/(Hz)^{1/2}$.]

Wuhan-Changsha Leg of Beijing-Wuhan-Guangzhou Fiber Optic Cable Passes Acceptance Check

93P60095 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 30 Nov 92 p 1

[Article by Ruan Xianghua [7086 3276 5478]: "Beijing-Wuhan-Guangzhou Fiber Optic Cable Communications Project Passes Acceptance Check"]

[Summary] All equipment and systems for the initial-phase construction of the Wuhan-Changsha segment of the Beijing-Wuhan-Guangzhou overhead fiber optic cable passed MPT-organized acceptance check a few days ago in Wuhan, and this segment will be formally operational in the first half of next year [i.e. 1993]. Overall technical performance meets late-eighties international standards. Equipment—including optical terminals, optical repeaters, automatic protective switch-over units, trans-digital-segment official telephone networking units, and monitoring/control/management units—was developed and manufactured by the Wuhan Institute of P&T Science. The entire 3000-km-long Beijing-Wuhan-Guangzhou fiber optic cable is currently the world's longest and highest-capacity optical communications trunkline, and is also the nation's first level-one trunkline built completely from domestically made equipment.

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